BROOKLYN BOTANIC GARDEN

PLANTS & GARDENS

1979

COMMUNITY GARDENING

Getting Started
Rewards and Pitfalls
Public and Private Organizations
On-site Experiences Across the Country

BROOKLYN BOTANIC GARDEN RECORD / PLANTS & GARDENS

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COMMUNITY GARDENING

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LETTER FROM THE BROOKLYN BOTANIC GARDEN

There is something new going on in horticulture these days, and it is exciting to see. This is the community gardening movement, which is beginning to involve thousands of people around the United States. It is essentially urban, and neighborhood self-help is the name of the game. Vegetable and flower gardens are sprouting up in inner cities across the land, and vacant lots are becoming green with beauty.

This Handbook, perhaps more so than others in the BBG series, is one of hope; but it is also one of case histories, if you will, of a wide range of community gardens, their successes, their problems, and how they got started. Let there be no misunderstanding: this is not an easy form of horticulture, as anyone who has grown plants in the city knows. One must cope with roving dogs, rubble, poor soil, contaminants of various kinds, vandals and, in some instances, bureaucrats. Yet community gardeners have persevered, and the harvest has been more than vegetables.

Pride has been the most important crop, with people doing things they didn't think they could, and thereby gaining confidence in themselves. Often, too, this pride is contagious, and community gardening is but the first step in neighborhood revival. This has been clearly seen in Brooklyn, where the Botanic Garden joins with Cornell in giving assistance to new gardens. Actually, one of the first instances of successful contagion in Brooklyn had to do with a venerable southern magnolia that a small group of aroused citizens in the Bedford Stuyvesant section, led by Mrs. Hattie Carthan, saved from a "Model Cities" housing development. From it sprang the Magnolia Tree Corps, consisting of young people who plant and care for other trees in the area, and the Magnolia Tree Earth Center.

Guest Editor Robert A. Wearne has carefully selected a number of community gardening programs around the country for commentary by people who have had a role in them. A quadruple number could have been included! Let us at this time warmly thank Mr. Wearne and his twenty-four contributors for providing inspiration and valuable information about organizing a community garden.

If you are interested in this subject, there are two other Handbooks in the BBG series that should be particularly helpful. One of them is *Natural Gardening,* also guest edited by Mr. Wearne, and it deals in good measure with the controversy about "organic" gardening. The other Handbook is the *Home Vegetable Garden*, which provides down-to-earth growing information on a wide range of food plants, as well as on BBG's own Children's Garden.

Good gardening.

Sincerely,

Frederick McGourty, Jr.

Editor

COMMUNITY GARDENING

Robert A. Wearne

Gardening has long been considered an activity associated with the landscaping and the culture of plants on the land or premises around individual homes. But life styles have changed, and where people live has also changed. It is an urban country now. Whether by necessity or choice, more families and individuals live in multi-unit dwellings, and gardening sites for many people have been virtually eliminated. Yet, the self-fulfilling desire and need for the rewards of gardening still exist.

Having a "place to garden" has been recognized for centuries in many countries as being essential to the mental and physical well-being of their people. In the United States the establishment of community "Victory" gardens for food production had a surge of popularity during World War II. When hostilities ceased so did public and political support for these gardens, and this physical and therapeutic activity was no longer available to many would-be gardeners. In the late 1960's home gardening and community gardens again became a popular activity, but not strictly for the production of food as during World War II. People now garden because of their preference for the taste of fresh, homegrown fruits and vegetables, and as a hobby that provides both mental or therapeutic rewards, for physical exercise and to save money.

The purpose of this Handbook is to provide information essential to the establishment of successful community gardens. The articles have been prepared by people with knowledge and experience about planning and organizing community gardens, and when once established, the effective strategy for perpetuating the garden sites. Throughout the United States, athletic fields, jogging trails or tennis courts are accepted in practically every community. Community gardening is even more an essential part of the American way of life. ❧

USDA/William A. Carnahan

A brief history of . . .

COMMUNITY GARDENING IN AMERICA

Thomas J. Bassett

In America there have been seven distinct though overlapping periods of allotment or community gardening. Unlike the European gardens which became institutionalized early in their history, America's activities can be more accurately described as "movements" of community gardening programs. I have labeled these periods the Potato Patches (1894-1917), the School Gardens (1900-1920), the Garden City Plots (1905-1920), the Liberty Gardens (1917-1919), the Relief Gardens (1930-1939), the Victory Gardens (1941-1945), and the Community Gardens (1970 to the present). Embedded in a series of social and economic crises, these movements have been promoted by reformists as measures to help society adjust to living under stress. Under the banners of work relief, nature study, civic beauty, patriotism, or wholesome food production, community gardening has been seen as one way of sustaining morale and supporting the large cultural framework.

Early Movements

In the wake of the Panic of 1893 came a period of industrial slowdown and unemployment. For those who happened to be working, low wages, long working hours and miserable working conditions led to labor unrest. Inventors and reformists were trying to cope with the pressures of urbanization—notably the growing congestion and squalor in the inner city.

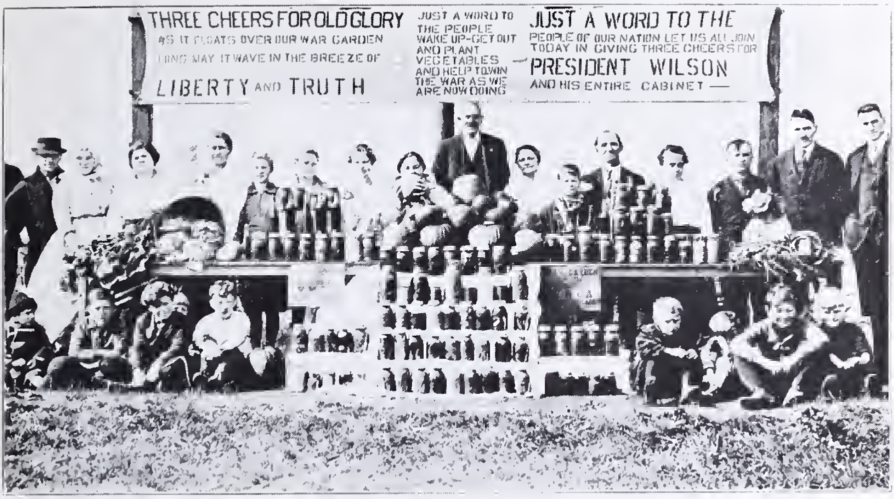
An early mayor of Detroit, Hazen S. Pingree, initiated an innovative form of poor relief by providing garden plots on municipally owned and privately donated vacant urban lands. Besides providing food, supplementing incomes and relieving strains on Poor Commission funds, the aim of his plan was to promote self-respect and independence, and to encourage the jobless to remain useful to society as producers. Allotment gardening was considered a healthful occupation as well as a means of assimilation for immigrants who might mingle with the native-born and learn the "American Way."

By 1895, 455 acres in Detroit were staked off into plots of a quarter and a third acre each. Principal crops were potatoes, beans and turnips. Pingree's scheme received much publicity, particularly when the figures showed that the Poor Commission's $5,000 appropriation reaped $28,000 worth of produce. Other major cities followed the Detroit example.

After 1900 and to the First World War, some civic improvers saw congestion and the absence of nature in the urban world as a blight that impaired the physical, mental and moral development of its residents. Educators feared that a child's growth was especially stunted by city life. The school garden was seen as a way to reestablish contact with nature while inculcating effective work habits and social attitudes in young people.

The virtues of the individual plot system (versus the communal arrangement) were stated in numerous journals and books. The site could be easily surveyed, the plots conveniently located and transferred, plot sizes (3′ x 5′, 8′ x 10′) could vary according to the age of the children and the whole operation could be organized and supervised with ease. Crops like radishes and lettuce were usually selected for their short growing season. With each child responsible for his or her "own garden," teachers could stress the virtues of economy, thrift, efficiency and good citizenship. In the end, the school garden was like a miniature city where pathways might be compared to streets and individual plots to houselots.

The Garden City Plots spread from the greening campaign that civic leaders had been advocating since the early 1890's. Hundreds of acres of unproductive land, in the form of backyards and vacant lots,


THREE CHEERS FOR OLD GLORY
AS IT FLOATS OVER OUR WAR GARDEN
LONG MAY IT WAVE IN THE BREEZE OF
LIBERTY AND TRUTH
JUST A WORD TO THE PEOPLE WAKE UP-GET OUT AND PLANT VEGETABLES AND HELP TO WIN THE WAR AS WE ARE NOW DOING
JUST A WORD TO THE
PEOPLE OF OUR NATION LET US ALL JOIN TODAY IN GIVING THREE CHEERS FOR
PRESIDENT WILSON
AND HIS ENTIRE CABINET —

T. J. Bassett

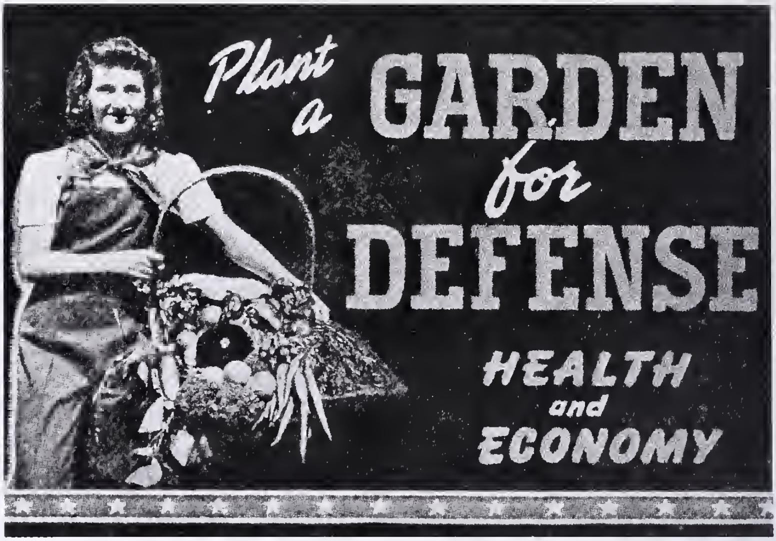
Employees of Inland Steel, Chicago, with homegrown fresh and canned vegetables, displaying the pride and patriotism that helped to "Can the Kaiser."

were viewed as blemishes that demanded attention. In 1912 the Garden Club of Minneapolis was busy bringing the great, green world of nature to the city. In that year 150 acres were under cultivation. Vegetables became so abundant that local grocers began to complain. The Garden Club argued that its enterprise was not for charitable but for civic purposes; that is, the benefits of vacant-lot cultivation were to reach a larger segment of society than poor-relief did. A new sociability that cut across classes had been aroused; health was improved; money was saved; and rest from the tensions of urban life was gained through gardening.

When America entered the First World War, the cultural context changed once again. The Kaiser was assaulting democracy in the world, and the call had gone out on the home front for "soldiers of the soil" to dig in vacant lots, to "plant for freedom," and to "hoe for liberty." The degree to which Europe had depended on commerce for the bulk of its foodstuffs, the effectiveness of German submarine warfare, and the limited agricultural production of both European and American farmlands caused food shortages throughout the war. The National War Garden Commission, organized in 1917, aimed "to arouse the patriots of America to the importance of putting all idle land to work, to teach them how to do it, and to educate them to conserve by canning and drying all food that they could not use while fresh." Even children were mobilized with the formation of the U.S. School Garden Army. The transformation of vacant land into community gardens earned these little tillers a rank of the highest patriotic order.

The Depression and After

The Great Depression stands out as a major crisis in American history. Within that period a series of temporary and permanent institutions were formed to confront economic and social turmoil. Relief gardening appeared on the scene to maintain the physical and mental health of thousands of the unemployed. By providing a means of supplementing their subsistence needs as well as involving the unemployed in work roles, gardening helped to reinforce a manner of living traditionally sustained by the discipline of work. Rooted in economic unheaval, relief gardening was an enterprise quite different in its impetus and values from the later Victory Garden movement. There was even a difference in the vegetables



T. J. Bassett

Defense Garden poster for 1942

raised. During the Depression potatoes and beans, staple foods, were harvested on plots averaging 50′ x 100′; the typical Victory garden of World War II yielded more leafy green and yellow vegetables in allotments of 25′ x 50′.

The National Victory Garden Program, directed officially by the War Food Administration, was essentially a five-point plan: (1) to lessen the demand on commercial supplies of vegetables and thus make them more available to the Armed Forces and lend-lease programs; (2) to reduce the demand on strategic materials used in processing and canning operations; (3) to ease the burden on railroads transporting war munitions by releasing carriers formerly reserved for produce; (4) to maintain the vitality and morale of Americans on the home front through the production of nutritious vegetables in the out-of-doors; and (5) to preserve fruits and vegetables for winter and future use when shortages might become even worse. The plan called for cooperation and adjustments, and health and economy were stressed. At peak production in 1944, twenty million Victory gardens yielded 40 percent of the fresh vegetables consumed in the United States.

Two factors are cited for today's increase in popularity of vegetable and community gardening. The rise of environmental awareness in the late 1960's and early 1970's stirred many to return to the soil. Also, inflation and unemployment created an economic motivation. The year 1975 was big for community gardens, with over 40 per cent of existing programs (today estimated to include close to two million gardeners) getting their start in that year of sharply rising food prices. A great variety of vegetables are presently cultivated in plots which, on the average, measure 20′ x 30′.

Groups as varied as their gardens are taking part in the movement—the young, the elderly, the poor, the well-to-do, the student, the suburbanite, the imprisoned and the handicapped. The incentives include ecology and economics, freshly picked vegetables and increased neighborliness and a sense of completion and success from overseeing an operation from inception to fruition. It might be added, too, that nutritional education has received much attention since the Second World War and has become an important consideration for federal funding of community garden programs. ☘

New Opportunities . . .

THE MASTER GARDENER PROGRAM—A CHANCE TO SHARE

Robert E. Kozlowski

What are the best varieties of tomatoes to grow? How much fertilizer should be applied to a lawn? Why are my apples wormy? These are but a few of the questions to which thousands of home gardeners seek answers from libraries, botanic gardens and county extension organizations.

To help respond to increasing numbers of such inquiries many Cooperative Extension offices across the country have implemented a new program. The effort, which may go under a number of different titles but is generally referred to as the Master Gardener program, provides access to the talents and enthusiasm of hundreds of volunteer gardening experts.

Since evolving in 1973 within the state of Washington, the Master Gardener program has expanded considerably in the geographic area which it serves and the number of volunteers which it involves. There are now at least portions of eighteen states that are involved in the program. The Cooperative Extension Service is supported through county, state and federal funding, and as part of the Land Grant University system it is able to offer

Robert E. Kozlowski

A Master Gardener from Long Island, New York, receives certificate acknowledging completion of his formal training.

R. E. Kozlowski

Volunteers from Central New York are updated in vegetable gardening techniques as they tour community gardens with Cornell University vegetable specialists.

a broad spectrum of educational programs. Under the system each state and county decides if and how it will develop a program such as the Master Gardener effort, thus accounting for the differences in titles (Garden Advisors, Community Gardeners, Star Gardeners, Good Life Gardeners) and structure of the program within various states and counties.

Housewives, businessmen, hobbyists, farmers, students and retirees are but a few of the types of individuals who become interested in the program. All volunteers are recruited on the basis of their gardening experience and willingness to share horticultural skills and interests with others in their community.

How it Works

To assure that volunteers are equipped with the most up-to-date information, they are provided with an intensive horticultural training program. A typical curriculum includes 30-60 hours of formal course work conducted for the most part by Land Grant University faculty and County Extension staff and personnel. An early phase of this training usually includes lectures having to do with the basic horticultural sciences—soils, plant nutrition, plant physiology, entomology, basic plant pathology. Using such course work as a base, volunteers are then exposed to information having to do with more specific horticultural areas, for example, home fruit and vegetable gardening and care of trees, shrubs and home lawns. Although the specific topics are generally more popular with more volunteers, the basic science courses are needed to provide a knowledge foundation upon which volunteers can build and reason. Often it is not until volunteers are looking at plant problems and making recommendations that they realize why both types of training are important.

As part of their training, volunteers usually receive a variety of reference material, including Extension publications from several states and the U.S. Department of Agriculture. When volunteers become involved in horticultural programs and problems their reference collection becomes a personalized gardening encyclopedia. They take pride in their ability to quickly provide detailed horticultural information dealing with a variety of topics.

As a rule, formal classroom training takes place in winter and early spring so Master Gardeners will be ready to become involved in programs at the start of the growing season. As volunteers conclude formal training courses they will usually be given an examination to certify that they have the background and knowledge to work within the program. Having proven their abilities, volunteers are awarded training certificates and are provided with identification name tags and/or jacket patches.

In addition to the initial formal training, many Extension offices provide their Master Gardeners with seasonal information on current garden problems and new horticultural developments as well as a newsletter to keep them abreast of community gardening activities and local growing conditions. Review sessions and field trips during the growing season give volunteers the opportunity to discuss experiences and problems they have encountered.

What is Given

In return for the training which they receive, Master Gardeners agree to work a certain number of hours within Extension-related activities. This amount of time varies from situation to situation and ranges from 10 to 200 hours. In nearly all cases, however, the amount of time volunteered far exceeds these initial expectations. In New York State one dedicated volunteer was reluctant to provide any indication of how much time he was spending with the program for fear that he would not be allowed to continue to volunteer after contributing his required hours!

Volunteers are working within their communities in different capacities. Under the guidance and direction of Extension horticulturists, Master Gardeners are able to provide a personalized type of service to large numbers of gardeners. In cities they provide information through clinics located at community vegetable gardens, local libraries and civic centers. Volunteers in rural areas often work within their local community providing gardening advice, soil testing and plant diagnostic services, using their own gardens for demonstration purposes. In metropolitan areas, Master Gardeners frequently spend time on call at an Extension Center for the purpose of answering home gardening questions.

As Master Gardeners gain experience they are able to provide their communities with many types of horticultural services. It would not be unusual, for example, for volunteers to present educational programs at a school for the mentally retarded or at a home for the elderly. In eastern New York volunteers have worked closely with the Foundation for the Blind in developing vegetable-herb gardens with Braille labeling for plants. These types of programs provide something special for all involved. The students appreciate the personal attention they receive and the Master Gardeners feel a sense of accomplishment in being able to share their skills with people having little exposure to the world of gardening.

The enthusiasm, willingness and dedication of the volunteers involved in this program have been outstanding. With the continued support of local Cooperative Extension Associations, and the back-up of Land Grant University Extension staff, it has the potential to efficiently provide the beginning gardener as well as the experienced horticulturist with much needed information about plants and gardening. ☘

Challenges and rewards of . . .

THE COMMUNITY GARDENING COORDINATOR

Mark Malony

For building a successful community garden the volunteer or professional coordinator must understand his role in: getting the idea of the garden across to the community; encouraging and obtaining permission for community gardening to take root; creating visible examples of positive community gardening experiences; and facilitating participation toward individual self-reliance and a self-sustaining project.

"Community gardening improves the quality of life for all people by beautifying neighborhoods; stimulating social interaction; producing nutritious food; encouraging self-reliance; conserving resources; and creating opportunities for recreation and education." This statement from the California Council for Community Gardening (Box 1715, Los Gatos, CA 95030) clearly expresses the variety of benefits derived from the simple action of raising vegetables.

Our metropolitan areas can be seen as a set of concentric bands with municipal and cultural institutions at the center, followed by business, industrial, residential and agricultural zones. Only open space/park land is more removed from the urban center than agriculture. The community garden is the urban dweller's response to diverse individual needs brought on partly by the *de facto* segregation of living/working space from life-support space. The person/plant connection is an ancient one. Plants, and therefore gardening, can be psychologically and spiritually healing by re-establishing that connection, as Charles Lewis, one of the country's leading proponents of urban gardening, has pointed out (see p. 14).

However, coordinators may find that none of the above benefits are sufficiently motivating to stimulate community participation. This can occur when there is a prevailing negative attitude toward working the soil. To paraphrase Frances Moore Lappe, it is more difficult today for people to return to growing the food they need, because growing food has come to be associated in their minds with hard work (F. Lappe and J. Collins, *Food First*, Houghton Mifflin Co., Boston). In this case, working with one or two families to quietly build a gardening showplace, then gradually expanding participation, may prove more successful in the long run.

Getting Permission

At times, a negative attitude toward gardening will manifest itself in more than just a lack of enthusiasm. In one city, storage of "waste organic material," and therefore composting, was illegal. In another, citizens successfully petitioned the city planning commission to stop development of a community garden on grounds that it would be unsightly, smelly, and would lower property values!

Even when seeking a lease for vacant land, the coordinator is faced with the task of securing permission. It is therefore useful to be able to document the benefits of community gardening with examples from as close to the community as possible. Visiting other projects furthers the exchange of ideas and information. This can be valuable in preparing a presentation or proposal.

Creating a positive public image for community gardening helps. Have the project endorsed in writing by a local minister, for example, or the park and recreation director. To improve the image of gardening among teenagers, it may even be desirable to have a local sports figure publicly encourage participation through a personal appearance or statement in the press.

Follow in Successful Footsteps

The best way to insure a positive community response is to cite a beautiful and productive example. Nothing goes over better at an introductory meeting than slides of a lush and thriving garden taken at a nearby neighborhood project. Nothing will set a program back more than to have a community garden fail for lack of leadership in dealing with a minor problem that grew out of proportion. In particular, programs with limited personnel or funds should maintain their focus on a few very successful demonstration projects, gathering a track record with which to stimulate greater participation or to seek further funding. The credibility of a coordinator will be enhanced if he has a successful garden of his own to share.

With limited resources, time or staffing, a considerable amount of visibility, and therefore community support, can be gained by starting a "foodscaping" project such as landscaping the grounds around a public building or school with edible plants in an attractive design. By propagating plants and recycling lumber, a coordinator can prove that existing community resources can be redirected to serve the program without great expense or effort. Make sure that every step of any garden project is well documented with photos.

USDA/William A. Carnahan

A community garden group ideally includes a diversity of skills and experience matched with enthusiasm and fellowship.

Sharing Experience

It is unwise for a coordinator to let participants become overly dependent on him because, if funding for his position is discontinued, as happens frequently, the program will be in jeopardy. True, it is often easier for the coordinator to go out and repair a water pipe himself than to organize a work party to deal with the immediate problem, or to organize a committee to take on the long-term responsibility. However, the third or fourth time the job falls to the coordinator, by precedence, the merits of facilitating self-help become obvious.

Both the volunteer and the professional will find their roles varying from planner and plumber to organizer and mediator. But remember, efficiency is not as important as experience to the participant. A coordinator's time is better spent teaching composting than making compost.

Better still would be for the city to establish a composting program. Our communities have considerable potential for supporting urban agriculture with recyclable lumber, trucks, tools and organic materials. Knowing who, what, when, where and how, and more importantly, sharing that knowledge with the gardeners, will simplify problem-solving. Facilitating self-help by establishing new networks for resource and information exchange is a major step toward program stability.

Community gardens often mature slowly, particularly where fall and winter gardening is not popular or practical. By the third year a garden will have experienced many of the problems that can arise. A good indicator of how well a coordinator has done his or her job is how infrequently the participants require guidance.

Just as the individual gardener finds satisfaction in the healthy development of plants, so a coordinator is rewarded by the growth of the participants. Community gardening is a new expression of the gardening heritage once passed from father to son, reestablishing not only the person/plant connection, but the person/person connection as well.

QUESTIONS ABOUT COMMUNITY GARDENS

Q. *Why community gardening?*
A. Although gardening is a simple skill which nearly anyone can develop, it does require certain resources which are not equally available to all members of a community. The most obvious, and one of the most important reasons for organizing a community garden program, is land. Many people residing in cities and towns simply do not have an adequate place available to them to plant a garden.

An important service which can be included in a community garden program is to provide physical assistance for people who have a place to garden but cannot do all the work themselves. An attempt can be made to arrange for plowing or rototilling of individual garden plots at minimum cost, and volunteers might be recruited to help elderly or handicapped people establish their gardens.

Q. *What resources are necessary for community garden program?*
A. The only essential resources are land, water, seed, equipment and people. A wide variety of approaches are possible to obtain these resources. Again, there is no "right" way to go about it; your program must be tailored to fit the unique conditions, needs and resources of your community.

Q. *How can suitable land be obtained?*
A. Many community garden programs obtain the use of vacant city, county or stateowned land, including building lots, future park sites or space in existing parks. Other programs have obtained permission to use or lease land from private owners, churches, schools and businesses. Land should be sunny, well drained and tillable. Transportation should be considered, particularly if participants are expected to bring tools and hoses with them each time they come. Try to find land which will be available for at least two or three years. Initial preparation of a garden site usually involves more work than will maintenance in later years, and it is demoralizing to lose this investment of time and effort after the first season.

Q. *What about water?*
A. Thought should be given to the availability of water before sites are selected; the cost of having water pipes installed can be prohibitive, but can also be readily done with volunteers if water mains and meters are accessible. If water is metered in your community, consider asking the city to subsidize or share the cost. In some programs, water trucks have been provided to successfully solve the water problem.

Water use can be substantially reduced by encouraging the incorporation of humus, as in the form of compost, into the soil and the surface application of mulches to prevent rapid drying out of soil.

Q. *How can community garden programs be financed?*
A. Funding is not an absolute requirement for community garden programs; some programs operate with no expenses at all, and others require no outside source of funds. However, if there are program expenses such as land lease, preparation costs or paid staff, consideration must be given to financing.

In most cases, a reasonable charge is made for use of garden plots ($10 is an average seasonal charge). In addition to this revenue, outside funding is often sought from local government, private organizations or service clubs. A wise approach to funding is one which will best facilitate the continuing maintenance of

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Adapted from *Community Garden Handbook*, Hunger Action Center, Evergreen State College, Olympia, Washington.

USDA/William A. Carnahan

Younger gardeners are especially intrigued by the magic of seeds growing into big (sometimes very big) plants. It's a wonder that all gardeners share.

an active community gardening program.

Q. *Will vandalism be a problem?*
A. Administrators of community garden programs generally agree that some vandalism is unavoidable when constant surveillance is not possible. It is usually held to a very small degree by the different time schedules of participants, which results in someone being in the garden all day. People living near the garden site will often be willing to keep an eye out for unusual activity. The small amount of vandalism that has occurred has not seriously dampened the spirit or enthusiasm of community gardeners.

Q. *What about liability insurance?*
A. It is strongly advisable for the sponsoring group to obtain liability insurance for personal and property damage. Such policies are available in most states for a reasonable amount.

Q. *How are participants selected?*
A. The most successful community garden programs are those which encourage diversity among gardening participants. Many programs have begun with a primary "target" population in mind, but have also encouraged open participation from all interested gardeners. Some people respond negatively to programs which appear to serve only low-income people. Special outreach efforts and consideration can be extended to recruit low-income groups, the elderly, handicapped or youth. ⁂

THE HARVEST IS MORE THAN VEGETABLES OR FLOWERS

Charles A. Lewis

"Community Gardening" suggests two kinds of associations: community—an association of people, and gardens—an association of plants. While the major portion of this Handbook concerns gardening projects, in this article I will concentrate on the people who garden and the kinds of social and personal satisfactions they find through this activity.

Why do people become involved in community gardening? The thought of producing your own food, one hopes at reduced cost, is often the initial inducement. The mental image of picking your own red, ripe tomatoes, like those pictured on the seed package, is enough to start people on the horticultural rituals.

The community garden is a friendly environment where gardeners work side by side, each at his own plot, watering, weeding, transplanting, staking, sweating and hoping. While nurturing their plants, sharing gardening knowledge, mentally matching the growth of their tomatoes against that of their neighbor's, they come to know each other. It is difficult to be unsociable while resting after pulling weeds or imparting the wisdom of mulches. During the time it takes for tomatoes to change from little round green balls to larger fruits, turning salmon-pink, then red, gardeners will share many experiences in common that create a sense of community.

There are countless examples of people coming to know each other over the garden fence. Milwaukee gardeners, who come from many parts of town to the huge community garden at the airport, have told me that one of the most pleasant aspects of gardening is getting to know the other gardeners. In Chicago, urban gardeners say, "we share our produce and we share ourselves." In Philadelphia, a resident of a gardening block commented, "It's so nice to come to know the names as well as the faces of the other people on the block. I never knew them before." In New York City, "We didn't grow just vegetables, we actually grew hope." Obviously there is more to gardening than growing tomatoes and snapdragons.

The sense of friendliness that develops in the garden can be the first step toward revitalization of an entire neighborhood. In Chicago, New York, Philadelphia and many other cities, people who joined together to grow vegetables and flowers, also joined together to clean up streets, paint and repair their houses, becoming concerned about the quality of life in their neighborhood. Indeed, workers in community rehabilitation are now using gardening as a technique for improving the social climate of a neighborhood.[1]

Are there personal benefits that are not dependent on the presence of other gardeners? Ultimately one gardens for one's self. The highly personal quality of each garden can be seen in the way plants are arranged and grouped. Paths, edging, plant supports, all lend a personal touch, evidence of the individuality of the gardener.

Think about the gardening process. You plant a seed, water it, care for it and watch it respond to your care. Every new leaf is an encouragement, every bud, bloom and fruit, proof of success. The gardener can rightfully feel proud of his accomplishment. Picking tomatoes, cucumbers or other crops is the reward for months of nurturing activities. The gardener's vegetables, purchased with hours of devotion, intelligence, physical effort and anticipation, carry greater personal meaning than those purchased with coin at the grocery store. In addition, one

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gains a sense of humility in a partnership that links human mental and physical effort with all the wisdom that is housed in a living seed or plant. Pride, reward, success, all help to enhance a sense of accomplishment and create feelings of self-esteem. Gardening helps people to feel better about themselves.

Pleasure Increases Over Time

Environmental psychologist Rachel Kaplan has been studying the kinds of benefits and satisfactions found in gardening and offers interesting insights.[2] Beginning gardeners usually start by growing vegetables, while long-term gardeners will often turn to growing flowers. She talks about the difference in rewards; vegetables offer practical rewards, while growing flowers offers the less tangible, sensory benefits of beauty, color and fragrance. It seems that the gardener who sets his sights on growing vegetables may find in the process of gardening deeper levels of personal satisfaction. The longer people garden, the more they find pleasure in its subjective rewards.

Rachel Kaplan surveyed over 4,000 members of the American Horticultural Society, most of whom are long-term gardeners, seeking information on the kinds of gardening benefits and satisfactions they found important.[3] At the highest level they placed the subjective, personal quality of peace and tranquility. At the next level of importance were the sensory joys of color and beauty of the garden. These two groups of intangible satisfactions ranked higher than the more obvious satisfactions of gardening—"producing some of my own food," "seeing plants grow," "growing odd or unusual plants." In the long run, it is the personal, intangible satisfactions that keep people gardening.

She concludes, "To think of gardens as a food source is reasonable enough as long as one does not stop with that. For rich and poor alike, the smells and colors are fulfilling. The sense that one is a part of the process of growth and in tune with nature is gratifying and recuperative." The shared experience of community gardening creates bonds of shared experience that transcend social and economic differences.

So be aware that when you turn that first spade of earth, plant seeds, or transplant seedlings, you may reap an unexpected harvest. There is self-esteem in snapdragons, truth in tomatoes and music in marigolds.

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About gardening habits . . .

WHAT GOVERNMENT SURVEYS SHOW

Evelyn F. Kaitz

In recent years almost half of all American households, excluding Alaska and Hawaii, have had fruit and vegetable gardens. Why do so many people have gardens?

The U.S. Department of Agriculture conducts numerous research programs that benefit farmers, consumers, regulators, legislators and industry. Consumer attitudes, motives and behavior about food are of particular concern and interest in these programs. National surveys have been conducted to help us learn more about fruit and vegetable gardening, and freezing and canning home-grown produce. The information in this article is based on USDA-ESCS *Surveys on Home Gardening*, conducted in the spring of 1976, winter 1977 and winter 1978.

With food prices steadily increasing, consumers are faced with a budgeting problem—trying to make their food dollar go further. Clearly, home gardening and the preservation of home-grown fruits and vegetables are ways people can reduce their total food costs. While an attempt to save money is the second of the three leading reasons mentioned in USDA surveys for having a garden, a preference for better taste or quality of homegrown produce is mentioned most often. The third reason given is that home gardens are a hobby—providing satisfaction, pleasure and pride. A small but increasing percentage of people surveyed prefer to grow their own fruits and vegetables because of concern about additives and preservatives in store-bought food.

Although the majority of home gardens are in the homeowner's yard, there has been a gradual increase in the number that are located elsewhere, *e.g.*, on a relative's or friend's land. Community gardens are increasing, too. In addition, people in apartments do some vegetable planting in containers on patios, roofs and balconies. Regardless of where they grow plants, as gardeners gain experience they tend to either increase the size of their gardens or have more than one garden plot.

What They Grow

Generally, the fruits and vegetables grown in home gardens have remained in the same order of popularity. Tomatoes, the Number One vegetable in America, are grown in almost every garden. Beans (green, wax or lima) are next in appeal, followed by cucumbers, peppers, radishes, green onions (scallions), lettuce, onions, carrots and corn.

Changes in the price, quality or availability in the marketplace of particular vegetables seem to cause changes in the percentages of households planting them. For example, when the market prices of potatoes and cabbage increase, coupled with the difficulty in finding good quality in stores, there is an increase in the percentage of gardeners planting these vegetables.

Strawberries and apples are the most popular home-grown fruits, raised by 20 percent of gardening households, but home production of fruits is not as popular as that of vegetables. Melons, peaches, pears and berries such as raspberries, blackberries and blueberries are grown in 15 percent of home gardens.

Each year there is a large group of repeat gardeners. About half of the households whom the USDA surveyed had had gardens for eleven or more years. There is also a fairly consistent group of nongardeners. Some, though interested, do not have a place nearby in which to grow vegetables. The availability of space, through community gardens and USDA's Urban Gardening Program, increases the possibility that some of them will garden someday. However, some people are just

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A community cannery in Herndon, Virginia, involves all ages and talents to can tomatoes, corn and other local bounty.

not interested and even with space available probably will never be.

Not all gardeners have freezers but those who do, generally freeze their fruits and vegetables. Fruits most often frozen are strawberries, apples, peaches and berries, but freezing homegrown fruits is less popular than freezing vegetables. Beans are the most commonly frozen vegetable. Corn is second, with peppers and peas tied for third.

Canning Homegrown Produce

Although freezing homegrown fruits or vegetables is more prevalent than canning, canning is done in about half of the households that have a garden. Tomatoes, followed by beans, are the most popular vegetables for canning. People who have gardened for a number of years are more likely to can fruits and vegetables than are new gardeners. ☘

Growing plants can help us better understand ourselves . . .

THERAPY THROUGH HORTICULTURE

Diane Relf

Horticulture has long been recognized as an important activity in therapy and rehabilitation programs. In the early 1800's Dr. Benjamin Rush, a Philadelphia physician and botanist, observed the curative effects of "digging in the garden." During this same period, the Friends Asylum for the Insane opened in Philadelphia and employed patients in vegetable gardening and fruit tree planting. Through the 1800's gardening was used in psychiatric hospitals to keep patients healthfully employed while producing an abundant supply of fresh vegetables for the institution. However, by the end of the century, a broader understanding of the personal benefits to be gained by gardening was beginning to develop.

The use of plants and gardens to enhance the learning of mentally handicapped children was cited by E. R. Johnson in the *Journal of Psychoasthenics:* "In the garden every sense is alert. How the eye brightens at the masses of gorgeous color and the beautiful outlines— How many things, hot and cool, rough and smooth, hard and soft, and of different forms are to be grasped and held by trembling uncertain hands whose sense of touch is hardly yet awakened."

Robert Carrol in 1910 presented a paper before the Tri-State Medical Society in Richmond, Virginia, citing specific cases in which it was demonstrated that gardening was not merely a passive diversion, but rather played a vital role in recovery. In the following years horticulture grew in recognition among occupational therapists. Between 1920 and 1940 almost all occupational therapy books mention gardening.

After the Second World War, a significant expansion in the use of gardening as therapy was seen in Veterans Administration hospitals. From then to the late 1960's, many of the horticultural therapy programs were initiated and conducted by volunteers. During this period horticultural therapy became a better defined and more widely employed skill. With this increased use came the recognition of a need for advanced training and communication among professionals. In 1972 Kansas State University offered training in horticultural therapy, and in 1973 the National Council for Therapy and Rehabilitation through Horticulture was founded. Today, eight universities offer advanced training in horticultural therapy, and NCTRH has over 750 members.

Programs

As a recognized therapeutic activity, horticulture is being used in a wide variety of settings. Among the programs and populations benefitting from horticultural therapy, one finds: vocational training for mentally retarded young adults; recreational therapy for the elderly; alternative action programs for juvenile delinquents; industrial therapy for psychiatric patients; physical therapy in general hospitals; occupational therapy in state institutions; work activity in prisons.

There are several reasons why gardening is of value in treatment settings. Plants respond visibly to care, without concern for the physical or mental abilities of their owner; they are non-judgmental and non-critical. The garden or greenhouse provides a non-threatening atmosphere in which people can interact, reaching out to help each other. A vegetable garden can satisfy some of our work ethic demands and, at the same time, it satisfies some of our need for mastery over our environment. Watching a seed germinate not only appeals to our basic creative drive but awakens a curiosity toward future events. Facing dead plants, weeds and insects helps us in dealing with the frustrations and disappointments of life. The awareness of our environment and our interdependence with plants can be an important part of learning to understand our own role in life.

Benefits of Horticultural Therapy

The goals and benefits derived from a horticultural program do not have to be defined by the size of the program. An African-violet on the windowsill can elicit as much sense of responsibility in some as a greenhouse bench full of poinsettias can in others. The important thing is to design the program to fit the needs and abilities of the people involved. The benefits of horticultural therapy can be seen in the social, emotional, physical and intellectual development of the individuals in the program.

Important social interaction comes through work with both peers and professionals. Of equal importance is interaction with the non-handicapped members of the community in such settings as plant sales and flower shows, where the individual is recognized for his abilities, not disabilities. *Intellectual development* comes with the acquisition of new skills, with enlarged vocabulary and increased curiosity. *Physical improvements* occur as the person participates in outdoor programs. For example, vegetable gardening requires the use of many different muscles, while fine motor skills are involved in activities such as potting seedlings. *Emotional growth* takes place as the person becomes more self-confident and has a better sense of his own self-worth by growing beautiful, healthy plants admired by others.

Although there are many horticultural activities that are useful in a therapy program, two of the most valuable are vegetable gardening and plant propagation.

Vegetable gardens have appeal for a number of reasons. They provide a legitimate work substitute for those denied a job by their handicap. They enable the gardener to be a contributing member of society. Well planned and properly laid out, they create an element of order over which the gardener has some control. They provide a valued product which the gardener can give to others—in contrast to his often repeated role as beneficiary of others. Besides which, the food tastes great and garden socializing is fun.

Plant propagation stirs interest on several levels. There is awe that where one plant existed, suddenly there are several. Along with this is excitement over getting "something for nothing." There also seems to be appeal to both the sense of creativity and responsibility, a feeling on the part of the gardener that having brought about a new plant by making a cutting, he is doubly responsible for its health and welfare. The gardener has a greater feeling of pride and attachment for a plant he has started than for one that was given to him.

Although the participant in a program may be active only a short time, his contribution to it should have implications for later participants. Our stay on earth is very short but the contribution we make while here should, and can, have positive influence on future generations. The following is an example of planning and intertwining of patient contributions that might be followed. A patient in late winter starts seedlings indoors and makes dried flower arrangements from flowers grown the summer before; a patient in spring sets out these seedlings, tends the garden and begins to harvest; a patient in summer weeds the garden, harvests and cans vegetables; a patient in autumn makes jack-o'-lanterns and collects seed of some plants for next year's garden, and so the cycle of interdependence proceeds. In long-term programs, year-round plans lend an excitement and anticipation for the future that is often missing in many institutions and similar settings.

For information on ways of working with other professions in Horticultural Therapy, write: National Council for Therapy and Rehabilitation through Horticulture, Mt. Vernon, VA 22121. ☙

From Germany . . .

THE KLEINGARTEN CONCEPT

Dee Peck

While I traveled by train through West Germany in 1976, my interest was piqued by glimpses of beautifully tended vegetable patches along the railroad right-of-way. I was fascinated by their perfection and even more by the utilization of what in most countries is usually a weed-infested wasteland. I had already come to appreciate the efficient use of growing space in Germany, epitomized by the orderly block-by-block planting, harvesting and replanting of trees for firewood in each small wood lot.

I decided to learn more about these miniature farms, so upon returning to home base in Munich I contacted city authorities, who started me on an intensive three days of observing and photographing the Munich *Kleingärten* (literally "small gardens" but technically "allotment gardens"). The railroad gardens I had seen were only the tip of a horticultural iceberg, comprising just 25 percent of the 800,000 *Kleingärten* in Germany, and available only to railroad employees. The remaining 600,000 are part of municipal lands and managed by the City Garden Department in each city.

In Munich I visited several of the 75 *Anlagen* (groups of *Kleingärten*) throughout the city. Some were raw, barely finished and still unplanted. Others were partially planted, and a few older ones were beautifully landscaped with a variety of plant material. All were carefully integrated into the city plan in order not to interfere with future development. They were scattered through the city but placed near transit lines to make them easily accessible. Most important, they were designed for beauty as well as utility. Each *Anlage* was secured by a locked gate and surrounded by a fence hidden in tall shrubs and trees. Outside this green barrier ran a wide public walk. The gate was unlocked during daylight hours and everyone was welcome to enter and wander along a network of secondary walks. However, the individual gardens were reserved strictly for the owners.

There were 50 to 400 small gardens in each enclosure, and each reflected its owner's individuality. Usually only a small part of a given plot was used for food plants, a situation which is reversed in times of economic hardship. When I saw them, each plot abounded in flowering shrubs and small trees, annuals, perennials—even tiny patches of manicured lawn.

How It Works

The city has a long waiting list for plots, so every new *Anlage* is quickly filled. Each plot is small, 300 square meters, and rents for 23 pfennig per square meter—a yearly rent of $30 (for property worth a hundredfold more on the open market). Many people enjoy the *Kleingärten* who could not afford them privately.

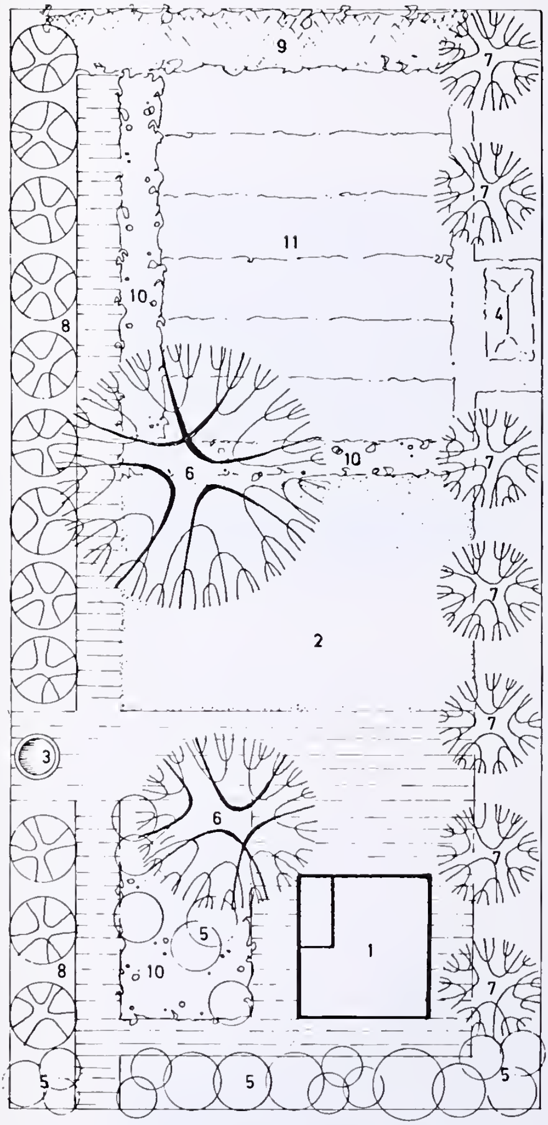
The city builds a small *Gartenhaus* on each plot for which the renter pays the equivalent of $2,500 (over a two-year period if necessary). These little structures are essentially a combination shelter and tool shed. They are not meant to be lived in, except perhaps overnight or for a weekend. If the plot changes hands, a government appraiser sets a value on the house and plantings, which the new owner pays. However, the gardens rarely change hands and may go from husband to wife to children in the event of death.

The government also runs a water line into each plot and leaves a supply of sand and pebbles as a base for walks and patios. A planting plan is suggested but not mandatory.

Also incorporated into each *Anlage* is a children's playground and a *Gaststätte* or common house for relaxation, conversation and business meetings. An association is set up, rules formulated, and a director chosen for each *Anlage*. He sees

Photos: Stuart Simon

Much of the basic garden-building materials, as well as the *Gartenhaus* and water, are provided at the site, but effort and dedication are still a necessity. The results (below) can be enormously rewarding, especially as the years go on and the plantings mature.



A typical Kleingarten master plan. 1) *Gartenhaus;* 2) lawn; 3) water; 4) compost; 5-8) shrubs and small trees; 9) raspberries and blackberries; 10) annuals, perennials and roses; 11) vegetables and strawberries.

that the gardens are cared for and gently reprimands the infrequent lagger. Representatives are sent to city, state and federal *Kleingarten* associations, and to the *Internationaler Grüner Kongress* (Congress of the Green International), held in a different European city each year.

A cross section shows that the *Kleingarten* population consists of 29 percent white-collar workers, 23 percent pensioners, 22 percent laborers, 19 percent officials and 7 percent self-employed. Younger people predominate in the newer *Anlagen,* but older people and families with children fill the established gardens. In all, 55 percent of the *Kleingarten* population is over 60 years of age.

Background and Social Implication

The *Kleingarten* concept was originated at the turn of the century by a Leipzig pediatrician named Schreber. More and more houses in the cities were being built without land, thus denying the inhabitants the contact with nature he felt was necessary to their well-being. The allotment gardens have not only supplied city dwellers with this revitalizing link with the earth, but have also fostered friendship and community spirit in a way he probably never dreamed of.

The concept has spread from Germany throughout Europe—north, east, south and west. The camaraderie and awareness of common concerns shown at the Congress of the Green International indicate that allotment gardening may well be an important step in the growth of international understanding.

We in the United States have a lesson to learn from the *Kleingärten.* Although urban community gardening is a vital and growing activity, we need to build into it a social meaning that will flow over into other areas of daily life. If community gardening here could be reshaped into the *Kleingarten* concept it might well provide a turning point away from the deterioration of our urban areas.

How it began and how it works . . .

THE ALLOTMENT MOVEMENT IN ENGLAND AND WALES

John Farmer

Toward the close of the nineteenth century, the son of an Irish aristocratic family was sent to America for the benefit of his health. There he undertook ranching, becoming a friend of Theodore Roosevelt, who later became President of the United States. These young men discussed, among other things, the application of cooperation to the agricultural industry. Returning to his native land, health renewed and fortune made, Sir Horace Plunkett put his theories about the land to the test. He started all kinds of associations for raising standards of agricultural products, processing and marketing. Soon his ideas spread, leading to the formation of the Agricultural Organisations Society, which appealed in the main to small cultivators, who were largely in the hands of none-too-scrupulous middlemen.

Background

A land hunger had existed in England for many years, but little was done either to satisfy it or to ascertain its extent until a land inquiry was encouraged by such reformers as David Lloyd George and Seebohm Rowntree. Not long afterwards, in 1908, the Small Holdings and Allotments Act was passed, making it possible to place land at the disposal of those who so badly needed it. A great pioneering movement then sprung up in the rural areas and, in spite of opposition from vested interests, large tracts of land were put under cultivation, either as small holdings or as allotments. It was about this time that the Agricultural Organisations Society was grant-aided to the extent of £10,000 a year by the Development Commissions to promote cooperation between farmers, small-holders and allotment holders.

This group was charged by the Government during the First World War with encouraging cooperation in the interests of food production. The most remarkable effect of the 1914-1918 war was to transform the allotment movement from a rural to an urban one, and 1917 saw the birth of still another society, the National Union of Allotment Holders. In 1930 the two groups merged as the National Allotments Society Limited.

During the postwar period, allotment associations tended to enroll those who were primarily interested in the gardens attached to their homes, and it was decided to add the name "Gardens" to the Society's title. Later, as a result of a merger with the Village Produce Associations, this name was also added to the title. Then in 1965, the Government appointed a Committee of Inquiry to review general policy on allotments.

The movement was then in such dire straits due to loss of members and land that the Committee might well have found that allotments were no longer needed to any great extent. However, the Committee, under the chairmanship of Professor Harry Thorpe of Birmingham University, subsequently President of the Society, presented its report to Parliament in 1969. It recommended that the emphasis should be put on gardening as a rewarding recreation, rather than on the over-emphasized and largely outdated economic motive. It recognized that the present generation of gardeners is not content with the status of urban peasants begging for doles of land, which were little more than horticultural slums, to keep them above the starvation line. Rather, the report continued, allotment gardens are an important part of the recreational and leisure system of the country and, as such, they have the right to a fair share of the community's recreational land.

The name of the Society was again

changed, in 1974, to the National Society of Leisure Gardeners. Among the targets of its interest are good design, amenity, good maintenance, productivity, family, community, growing for pleasure, growing for quality and growing to show. For the first time ever in peacetime, all available allotment plots were taken and waiting lists created, so that by 1977 there were more than 112,000 names on them. Land is still in short supply but pressure is being made on local authorities and the government to supply more, and the Civic Trust has established a Wastelands Forum to urge the release of still more land for gardening purposes.

Aims and Organization

The object of the National Society of Leisure Gardeners is to help all to enjoy the recreation of gardening and so promote their health, education and community fellowship. The Society aims to insure that facilities are made available to everyone who desires to garden, and endeavors to instill a better understanding of the fact that gardening is a recreation for the mind and body as well as a source of economic wealth both to the individual and to the nation.

For the purpose of administration, the Society is divided into twenty-three constituency bodies, each one electing a member to the National Committee of Management, which also includes three representatives of local authorities elected by postal ballot. Many are now thinking however that the work in Counties and Areas could be more efficiently and speedily handled by County and Area Committees, leaving the National Committee, to be elected on merit, with the responsibility of working efficiently on matters of national importance, and the task of distributing information on a variety of subjects to beginners and experts.

The standard allotment plot measures 300 square yards and was devised as being conveniently divisible into three portions to permit an easy rotation of crops. Variations in climate in England make it difficult to give growing hints, the north of the country being about a month later in cropping than the south. Again, seeds which may be sown in open ground in the south, can only be raised in greenhouses in the Midlands and north. In consequence, vegetable rows run from north to south rather than from east to west, for only thus can the sun shine down between the rows, ripening the crops evenly, and warming soil which would otherwise remain largely in the shade. To economize on space, intercropping is carried out largely with spinach, radishes or lettuce being sown between onion or parsnip rows; rows of lettuce being sown between rows of runner beans; stump-rooted carrots (for pulling young) being sown between rows of brussels sprouts; and cauliflower being planted between pea rows.

"Follow-on cropping" also forms an important part of our gardening, with an original crop of early carrots for pulling young being cleared from the ground by the end of May and being followed by a sowing of dwarf French beans; early peas being cleared by the third week in June and followed by a planting of leeks; early potatoes cleared from the ground by the end of June being followed by autumn cauliflower; and early cauliflower being followed by a sowing of carrots in the beginning of July.

To insure that the utmost use is made of whatever fertilizer has been put into the ground, and to minimize the spread of disease among closely related vegetables, the Society recommends that the planting of peas and beans follow broccoli, cabbage, parsnips, carrots or potatoes, which in turn may be succeeded by celery, leeks, lettuce, turnips and any members of the cabbage family and any other crop except spinach, turnips, parsnips, carrots, and salsify. Borecole (kale) may follow peas, beans, lettuce and potatoes and be succeeded by peas, beans, beets, carrots, parsnips, onions, potatoes and celery. Carrots may follow or be followed by any but root crops, celery, parsnips and turnips. Leeks may follow any crop but onions, garlic, shallots or chives.

The judicious use of leisure is said to be one of the greatest problems of our age. If by that is meant the use of leisure hours in the most profitable way, both for oneself and the community, then gardening ranks very high. ☘

SOME P'S AND Q'S ON URBAN GARDENING

Virginia L. Beatty

Preface: Gardening in the city is not the compression of rural or suburban gardening into an urban plot. Urban gardening is not agriculture, but a recreational, social activity that produces flowers and eatables as by-products while people are growing together. In the city, plants can be grown in any spot where desire, light and water are available or can be provided.

Procedure: People with a common purpose find a place to plant, get necessary permissions, plan, acquire plants, plant, protect crops, pick, preserve surplus and plan for next year. Learn by doing. Work with nature (plant and human) rather than against. Although nature's laws are immutable, the possibilities within them are infinite.

People: Growing in the city is a satisfying activity for people of all ages, sexes, physical capacities and socio-economic levels. Mixed groups have more fun and are more successful than segregated groups.

Purpose: The primary purpose is pleasure rather than profit or production. People feel happy exercising, relaxing and socializing in a neutral setting while producing food to eat, flowers to enjoy and experiences to share with others who also care.

Places: Plants can be grown in the ground or in containers on the ground or above the ground. The best growing places are close by where plants can be kept under a watchful eye. Plants can be grown individually or in groups in odd spots, conventional plots or on terraces and roofs. Containers can be purchased or recycled from materials readily at hand such as boxes, cans and automobile tires.

Questions: If answers to questions are not available from the group or the neighborhood, information can also be extracted from books, magazines or other people. Individuals in the Cooperative Extension Service, local botanic gardens or garden centers can be very helpful, although the information they provide may have to be translated from the rural to the urban priorities.

Permission: In the city, unless you are gardening on your own plot, it is prudent

V. L. Beatty

Gardening is an activity that accomplishes much more than simply growing vegetables.

to get permission and give public officials an opportunity to supply input and share in success. While a general blessing from city hall never hurts, the important individuals are the ward and precinct people. Especially useful are the fire and streets and sanitation departments. Many fire departments have vegetable plots and are resources for urban gardening know-how. They also may be able to provide permission and valves so you can use water from hydrants. If you plan your clean-up with the streets and sanitation departments, the trash collected can be picked up before it gets spread about again. In the fall, they can often provide leaves for mulch or compost.

Plan: Plan before planting. The people who do the planting should do the planning. Plant what you like to eat or are curious to see grown. Start small and learn by doing. Build on success. Individual or family plots grouped together are usually better than large community plots where a few do the work and many arrive for the harvest.

Plants: Plants, seeds and supplies are often readily available in the urban areas. Catalogs are useful, but people need help learning where to get them and how to use them. People interested in gardening can often work together and put on a plant sale in the spring and a bulb and perennial sale in the fall. Community sales provide opportunity for sharing information. For example, some plants are more productive, compact or pollution-resistant. Seeds packaged for 100-foot rows can be shared or saved. Saved seeds can be tested for viability before planting. Surplus plants can be shared.

Planting: Urban gardening is labor intensive. Mechanical equipment does not do well in small rubble-filled plots. Hand tools and pre-1940 gardening techniques work best. If you are not using tractors or mules, there is no need for rows. Hands, fingers and feet can be used as measuring instruments. If all the available space is covered with concrete or asphalt, plant in containers. A whole salad garden can be grown in a converted tire.

Quality: Seed, plants and tools should be of high quality. Half-dead plants, even if gifts, should be composted right away. A fire-hardened stick or a butcher knife is preferable to cheap tools that fall apart the first time they touch ground. In the city, each person and each plant is important.

Protection: Pride and peer group pressure protect most plots. There are no fences or walls that can keep out determined vandals, but a light fence is useful for keeping out animals and small children.

Picking: People should be encouraged to taste-test at different stages, but pick at the prime of quality.

Preserving: With small plots and small storage spaces it is usually more satisfactory to eat fresh and share with others, preserving the memory rather than the plant.

Publicity: Factual information is useful in helping people get together. However, a full media extravaganza before a program is well-established can be destructive since it often raises expectations that cannot be met.

Prizes: The reward of the urban gardener is personal satisfaction. Competitions separate people rather than bring them together. Prize competitions, usually sponsored by an external group, often create temptation to improve one garden's chances by destroying others. If something tangible is required, give out certificates of participation.

Progression and Positive Reinforcement: Start small, learn by doing, and build on success. Invite everyone interested to participate. Take pictures to record progress and show them at every opportunity. Share gardening pleasure and produce. Harvest feasts and harvest festivals can produce cookbooks, growing manuals and more opportunities for urban gardening.

Potential: Gardening in the city has unlimited potential for providing satisfaction, feeding body and soul and helping people grow together. ❧

Long-term community trusts and . . .

PERMANENT GARDENS

Jamie Jobb

Elmhurst. In another place, this name might imply polished vistas and manicured homes, exclusive easements and Mercedes Benz. But here, houses and warehouses inhabit the same block. Horns, bells, sirens sound day and night. Block after block, people rattle within this din. Although the tracks of trains, trucks, freeways and rapid transits march through it all, they seem to lead nowhere. Is this where Gertrude Stein thought there is no there?

Oakland, California, San Francisco's Cinderella sister, reaches out into the fog and smog on each horizon. Elmhurst is but one Oakland neighborhood crowded into the same boat. Light and heavy industry make rough neighbors. Kids maneuver sidewalks and streets, while landlords choose to live elsewhere. And all around, anywhere you look, the landscape is littered with empty lots. Valuable, but vacant, land.

Trust for Public Land

A former teacher, Elbertha Turner is young, gregarious and black. She feels at ease now in Elmhurst, although two years ago she had doubts. Then, she knocked upon every door that appeared to lead to a resident of the neighborhood. When doors opened, she asked pointed questions. Sometimes she got questions pointed right back. "TPL?" someone would ask when she introduced herself and her affiliation. "Is that another name for FBI?" It wasn't exactly a joke. She knew people had seen her standing out there, taking pictures, writing things down in notebooks.

Elbertha Turner indeed works for TPL, Trust for Public Land, which has commit-

Photos: Jamie Jobb

Trust for Public Land's Mitch Hardin points out Elmhurst's own neighborhood land reforms.

ted itself to orderly land reform in America. Now in its sixth year, TPL has established 28,000 acres of open space in public trust, and 68 percent of that acreage is concentrated in urban areas.

A TPL survey of East Oakland in 1975 found around 950 vacant lots in a 20-square-block area—over 125 abandoned acres. More than 65,000 people lived within a mile-and-a-half circle. TPL knew the problem and had ideas about how to solve it. Thus evolved the pilot project in TPL's National Urban Land Program. And this was why Elbertha Turner was out on 81st Avenue, knocking on doors. Trying to circulate a good idea whose time had come.

For those patient enough to listen, she outlined the program. She said the vacant lots didn't need to stay vacant. People could clean them up, put in trees and benches for a park, or a playground or anything useful on the land. She explained that TPL's "business" was to save land from speculative developments by persuading landowners to convey the property to TPL as a bargain sale or outright donation. Thus the landowners could enjoy tax benefits which compare favorably with the risks involved on open real-estate markets. Most of the vacant lots were owned by savings and loan associations and the City of Oakland. Many were tax-defaulted and could be purchased for the amount of back taxes. But that amount of money ($500 to $1,500) was out of reach for most Elmhurst residents. This didn't seem to matter to Elbertha Turner and TPL. There was a way, she said . . . all she needed was a solid show of support from the neighborhood.

Elbertha made it clear that TPL could not spoonfeed the neighborhood with land. The first step would have to be taken by the neighbors who could organize around not just the vacant lot, but also around the concepts behind its common use.

Slowly people in Elmhurst began to realize Elbertha was no bureaucratic paperweight, but a real person offering a positive means for neighborhood self-improvement. And when they saw that TPL was a legitimate charitable organization, they began to see those dumpy vacant lots in an entirely new light.

The Trust for Public Land has now acquired 40 properties in Oakland, with an assessed value of $150,000, for less than $10,000. About half of these vacant lots have been transformed into community gardens. TPL did not expect to be drafted into the big leagues of community gardening. It expected to maintain its charted course of acquiring and preserving open (but not necessarily sprouting) spaces. However, the community groups which organized around these lots wanted to grow food plants and needed things that TPL could help round up. Things like fences and water meters, and perhaps a grant for a windmill.

A *windmill*? In a vacant lot? This kind of long-term investment in an inner city neighborhood would have seemed absurd in Victory Garden days. But not now. The 39th Avenue garden in Oakland's Fruitvale neighborhood needed a windmill to pump water from its well during the recent drought and, well . . . TPL used its influence to help the gardeners find the design, funds and materials for the project.

After all, what could be more appropriate for a permanent garden site than a windmill with trees around it? A symbol of permanence erected by a group of people gardening within land held in common trust—not actually "owned" in any common sense of individual property, but held in common. The gardeners act as stewards, as caretakers rather than just plain takers.

Mitch Hardin, urban field representative for TPL, tells how a neighborhood land trust can be organized around the existing community power structures. "We organize around the strongest group we can find," Hardin said on one of his tours of Elmhurst. "And they usually are church groups. They're organized as a body and they understand the need for an active role."

But organization takes time and is not always easy. "In a lot of cases," he said,

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Adapted from *DUMP HEAP, The Journal of Diverse Unsung Miracle Plants for Healthy Evolution Among People,* © Winter, 1979.

On the left an Elmhurst garden held in trust; on the right . . . no trust.

"we have to educate people in many other things." For example, he points out the Fruitvale windmill. "People had to understand water conservation, they had to understand energy conservation . . . in order to get to the whole decision of 'Yes, we can have a windmill here!' . . . People have to understand their needs."

Hardin, who worked in real estate before joining TPL, has seen many sides of urban land reform. "In almost any city you care to look," he said, "there's enormous waste land. People say that land is the most valuable commodity we've got in this society. Over half the wealth of this country is in real estate. So it's like gold." But unused gold.

Other Trusts

California is but one state where gardens and farms are being planted on ground held in common trust (see p. 30). Most of these groups call themselves community or neighborhood land trusts. Others, depending on their orientation, have chosen to organize as parks foundations, open space committees or natural conservancies. A few are beginning to explore the possibilities offered by the Heritage Conservation and Recreation Service (the former Bureau of Outdoor Recreation), which emphasizes the compatibility of historic and recreational uses of land. And in many places, park and recreation departments have begun to recognize community gardening as a legitimate recreational activity.

Most of these neighborhood groups have organized themselves as tax-exempt organizations, recognized by both state and federal tax laws. This has allowed them to accept deductible donations—including land—and other grants-in-aid. Thus a group of people together can accomplish what none of them could do individually. Oakland has eight neighborhood non-profit groups assisted by TPL and established to hold land in trust.

These groups do not necessarily see gardening as their primary purpose. Rather, they see themselves as stewards who preserve the land—for its wisest and best use from a community point of view. This kind of use can include farming as well as gardening.

Near Smithville, Georgia, sixteen farming families are working more than 4,000 acres held in trust by New Communities, Inc. A diversity of vegetables, grapes, pecans, peanuts, watermelons, soybeans, corn, pork and beef are grown on 2,000 of the acres. The rest is occupied by small forests and swamps. New Communities claims to be the largest single-track black-owned farm in America. Plans call for an eventual new town with school, new housing and cottage industries on the land, so these people can become even more self-reliant.

In North Monmouth, Maine, a unique community garden is developing on a 32-acre plot held in trust by Sam Ely Community Development Corporation. The land was located in an area more suited for suburban housing than for agriculture, so the site was subdivided into four one-and-two acre model homesites. The remaining 28 acres became a common woodlot and growing ground. A pair of local banks even agreed to accept the trust-lease agreement as sufficient equity for home mortgages on the property.

Thus a quiet kind of land reform is being accomplished by a few gardeners, farmers and others committed to their cause. And one of the biggest benefits of this quiet reform is the security offered to community gardeners who can enjoy the spot fully by planting nut and fruit trees, berries, asparagus, and scores of other perennial plants.

Today the Trust for Public Land's National Urban Land Program has stretched its roots into the soils of other cities, including New York, Newark and Los Angeles. The program's director, Steve Costa, is proud of the progress made in just three-and-a-half years. He points out that the program has a wide scope that includes more than gardening. In other cities, TPL has helped groups create small parks, green belts, basketball courts, and greenhouses on former vacant lots now held in common trust. Many other lots have been "land banked"—cleaned up and held in reserve by a community trust with the expectation of selling or leasing the land for future community developments, which the neighborhood group must approve.

"We're looking for neighborhoods and organizations that have an overall neighborhood strategy, as opposed to wanting to focus on a specific piece of property," Costa said. He believes that groups can develop through vacant lots "a whole new land ethic in this country, and put people in a position of controlling a part of their environment." TPL's role has become one of a catalyst for neighborhood groups, government agencies, local businesses and large corporations to reconcile some of the differences between home and industry so visible at first glance in neighborhoods like Elmhurst.

Costa cited a recent TPL survey of 12 of America's most successful community garden projects. Nearly all of them were held by lease, rent or some other short-term agreement—or no agreement at all. The remainder were held in community trust or some other long-term arrangement, so the gardeners could plant trees and perennial food plants as well as annuals. The survey convinced Costa of one thing. "If in fact we're going to have a community garden movement in this country five or ten years from now," he said, "we need to take some steps to get these sites in some kind of permanence."

Land Reformers

The Evergreen Land Trust, P.O. Box 303, Clear Lake, WA 98235

The Heritage Conservation and Recreation Service, Department of the Interior, Washington, DC 20240

The Jewish National Fund, 42 E. 69th St., New York, NY 10021

The Land Institute, Route 3, Salina, KS 67401

National Community Land Trust Center, 639 Massachusetts Ave., Cambridge, MA 02139

The Nature Conservancy, 1800 North Kent St., Arlington, VA 22209

National Coalition for Land Reform, (eastern region) 1878 Massachusetts Ave., Cambridge, MA 02140; (western region) 126 Hyde St., Suite 101, San Francisco, CA 94102

National California Land Trust, 330 Ellis St., Room 504, San Francisco, CA 94102

People for Open Space, 46 Kearney, San Francisco, CA 94108

The People's Land Trust, 1000 Harris St., Bellingham, WA 98235

The Sam Ely Community Land Trust, 136 Maine St., Brunswick, ME 04011

The Trust for Public Land, 82 Second St., San Francisco, CA 94105 ✤

AMERICA'S BIGGEST LANDLORD FOSTERS TENANT GARDENING

Kate Serlin

"What's good for tenants is good for management," says Bernard Moses, New York City Housing Authority's Director of Management. NYCHA provides low cost homes to 600,000 residents in 250 projects—oases of order in depressed areas of NYC's five boroughs. Moses finds gardening boosts the morale of low income people surrounded by slums and beset with problems, hopelessness and negative attitudes. *Below:* Vegetables borne on the right side of the tracks and gardening tots in a Housing Day Care Center.

All photos: N.Y.C. Housing Authority Photo Unit

GROWING TOGETHER . . . The language of plants knows no ethnic or age barriers. Gardening is the most popular of all activity programs offered on projects because *everyone* can participate. Joint endeavors supply companionship and creative expression to stimulate and occupy mind and body.

VISION BECOM
TENANTS AN

NYCHA began the Annua
1963. Entrants are given $25
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REALITY FOR ANAGEMENT

na Gardening Competition in r ney and the choice of a garsk pers till for planting. One rc mushroomed on lawns the gi s. Of 1066 entries by 1978, ha ed buildings while 412 harbo . A Brooklyn family *(below)* le ream".

HOME IS WHERE THE GARDEN IS . . . Move-outs decline where gardens are at stake. Proprietary pride and actively used grounds reduce crime, vandalism and littering. Results that delight the eye and nourish the body are watched by bench loungers and hundreds of appreciative eyes from windows above.

EVERYONE WINS

All involved benefit from the Garden Program. Inspired programs led by Doris Sargent *(inset)* include year-round related educational/social affairs. BBG staff and other botanists judge entries. Fiercely sought awards go to top gardens in each borough; the best flower and vegetable gardens are City-wide winners. In City Hall awards ceremony, beaming NYCHA Chairman Joseph Christian, Mayor Ed Koch and City Council President Carole Bellamy present trophies to City-wide winner Corine White who beautified her whole floral setting including lawn care and to Vegetable Garden winner Leila Clark. ☘

Urban growing brings rewards . . .

THE NEW YORK CITY GARDENING PROGRAM

Sam Segal

The soil of New York City has never gone entirely neglected, strange as this may seem to country dwellers. All five boroughs have plant-minded groups of one sort or another, including botanic gardens and horticultural societies. Of course, the home gardens vary, some being lush penthouse kinds, others just windowsills devoted to tomatoes or onions. And largely because of the continuing influx of immigrants from rural areas, there have always been backyard oases of flowers, vegetables and fruit trees.

What changed in 1977, when Cooperative Extension of Cornell University began urban gardening in the five boroughs, was that community gardening—usually on vacant lots—became an organized movement.

Doubting Thomases Disproved

At first, while applauding the idea, many people doubted that large-scale gardening could work in a city dominated by concrete, skyscrapers and bureaucracy. Skeptics also predicted doom because of the much-cited lack of community spirit in so large a city and warned of rampant vandalism if gardens did get started.

Yet, even though many gardens did not get planted until late June and July that first year, about 1,500 did get under way. Almost all had harvests; vandalism was almost nonexistent; and in every corner of the city, groups of people with little or no prior social contact were working together and enjoying more than a vegetable harvest. And besides their personal rewards, the face of many a neighborhood was brightened.

By 1979, after two seasons, it was clear that urban gardening was not just a fad. The number of Extension-supervised gardens—on 319 scattered sites—had exceeded 2,000. More important, it became clear that community groups would not

The triumph of optimism over appearance.

Photos: N.Y.S. College of Agriculture, Cornell Univ.

dissolve, and their garden sites not be neglected, once winter came. In almost all cases, the site was cared for year round and reactivated early in the spring after the first year of work.

If It Grows Weeds It Will Grow Vegetables

Gardening itself has proved no problem. New York City soil will grow whatever rural soil grows in similar climates. Of course it sometimes needs help, and that is perhaps the major problem, because the cost of average-quality soil for an average-sized (60′ x 60′) community garden exceeds $500. Since this money has to be raised at the earliest stages and since New York's Extension gardening program is geared primarily to low-income groups, this can be a high hurdle.

The program does not advocate importing soil for the fun of it. If existing soil will grow weeds, we use it and simply enrich it as we go along. If some soil is needed, we try to minimize the amount. But when the bricks of a wrecked building are tumbled into the former foundation hole, the vacant lot that then sits on top of the covered hole will have "difficult" soil, and importing is sometimes necessary. Although Extension programs, being educational, are not allowed to give away money or soil, the staff can suggest local fund-raising events and ways to solicit money from local businesses.

If the initial expense, including perhaps another several hundred dollars for a fence, can be handled, then the gardening is simple enough. It should be added, though, that Cornell's kind of community gardening is made easier by the fact that Cooperative Extension does not recruit individuals and then try to put together a group; rather, Cooperative Extension seeks and responds to groups that are already organized.

The Way It Works

How would such a group proceed, from A to Z, under our program? If a caller says his block association might be interested in community vegetable gardening, we send printed material and arrange a meeting with the group itself or several of its leaders. (After the first year, once a mailing list has been compiled, such meetings can be scheduled for numerous group leaders.) A meeting is usually preceded by an Extension visit to the proposed garden site to make sure it has watering facilities and enough sun. At the initial meeting, the group is shown slides and given an outline on how to gain the use of the lot, and the main steps that lie ahead. It is also made clear that gardening takes work. As proof, the Extension professional usually sets the group a task, such as clearing the lot, and gives it a deadline. If the deadline is not met, this may indicate that the group lacks the organization and resolve to garden. If the group does meet it, then the educational and practical aspects proceed—from laying out the garden, to planting, watering, tending, tilling, and so on.

In each borough office there are professionals with backgrounds in both horticulture and nutrition education. Since the original program money came from a low-income nutrition-education program of the U.S. Agriculture Department, the New York program scrupulously incorporated nutrition education into gardening. This had several benefits: it gave year-round meaning to a summer pastime; gardeners were encouraged to get the most nutrition and taste out of their vegetable-growing; it made urban gardeners more aware of the ancient ties between food and soil; and a means was provided through Extension's traditional home-economics training, for teaching canning and preserving, promoting enlightened shopping, and keeping gardeners informed on new nutritional information.

Social Benefits

Since the program stresses community gardening, its most obvious effects are on entire neighborhoods, where one-time eyesores become oases. A New York City eyesore can indeed shock the uninitiated. For example, two months before planting, a Brooklyn site that now boasts 50 plots on a half-acre was piled knee-high with bricks, mattresses, dog carcasses, old car parts and plain garbage that was dumped in cartons, bags or simply scattered. Not only did the fenced-in garden area grow steadily and dramatically

With good soil preparation, New York City earth can produce a bountiful harvest (despite the incongruous background).

improve the look of the neighborhood, but the people thereby brought together also organized to reclaim the rest of the same vacant city block for non-gardening recreation.

Besides many stories of neighborhood change, there are also the individual successes that gardening helps produce. Leaders and followers even from street gangs have found gardening to be productive and, perhaps surprisingly, prestigious. Drug-rehabilitation patients have found it to be a path to success, which is often elusive in their lives. Former juvenile delinquents in Staten Island have grown large harvests and sold them at roadside stands. Residents of adult psychiatric homes have found the work invigorating.

For thousands of older people, gardening has provided tranquil, useful, moderately exerting work, in many cases for people who decades ago had grown up on farms but had long neglected their rural heritage.

To gain all these blessings, city dwellers have only to practice what men have been doing for millennia. There is no trick to urban gardening, though gaining the use of a site may require searching county tax records to find the owner. Often this is the City itself, but New York and other cities have tended to respond to the urban-gardening movement by cutting the red tape that can discourage the legal use of land. Once a group knows the procedures for gaining permission, once it has expert help and, if necessary, start-up money for soil and/or fencing, the road to success is easy if the group stays together. Whether it decides to farm communally or to allot separate plots within a site (or a combination), the harvest will be fun if the people are united. ☘

Involving the community in horticulture . . .

PHILADELPHIA GREEN

J. Blaine Bonham, Jr.

Helen Feggans, President of the West Bank Civic Association, called me a few months ago for a statement of support in behalf of her community. The Association's board was preparing a great proposal to approach local private foundations for money to rehabilitate several houses. This eight-block section of southwest Philadelphia called West Bank is located along the Schuylkill River, and like many neighborhoods in Philadelphia gradually changed to an all-black population a few decades ago as whites moved out to follow the shifting job market. Houses were abandoned and boarded up. In 1973, the neighborhood leaders decided to form a Civic Association. Though they attempted to work through the municipal bureaucracy, West Bank's leaders were frustrated with what they felt was a lack of city interest in investing local or federal monies for community development.

I first met Helen Feggans, Charlotte Donald and the rest of the block leaders at their neighborhood center in December, 1976. Feggans had heard that the Pennsylvania Horticultural Society sponsored gardening programs for well-organized community groups, and their board was anxious to hear what we had to say. These people had been frustrated before in attempts to help themselves. They patiently listened to my explanation of our vegetable garden program and window box program. I stressed that the programs required broad community support and participation. Their shouts came—"That's no problem with us." What they were concerned with and, I think, a bit skeptical about, was how we would hold up our end of the bargain. That we were a private, nonprofit organization, unimpeded by red tape, didn't seem to matter. They had been promised things before. They were willing to deliver; they wanted us to deliver, too.

In the spring and summer of 1977, the neighbors of West Bank, with technical assistance, materials and encouragement from our staff, planted two gardens covering 8,780 square feet with vegetables and built and planted 200 window boxes and tire urns with annuals. They also developed a 12,000 square foot vegetable garden with Penn State Cooperative Extension Service's Urban Gardening Program to serve as the Demonstration Garden for southwest Philadelphia. West Bank was abound with self-satisfaction and pride by the end of the summer. Functioning as a community, they had succeeded.

Symbiosis of Plants and People

That year, 1977, was the Society's third year of offering its vegetable gardening program to Philadelphia community groups. We had also assumed responsibility for conducting the Neighborhood Garden Block Program (planting window boxes and tire urns). Being horticulturists, we believed in the symbiosis of plants and people. Three years of gardening on the streets of Philadelphia had revealed to us the large-scale effects that a gardening project could have on a community organized behind the effort.

Through news media and word of mouth, requests from groups of people were flooding our office. At that time, three full-time and one part-time horticulturists comprised the community activities department of the Pennsylvania Horticultural Society. We were assisting thirty-five new groups annually to plant vegetables as well as forty new and second-year blocks to garden in window boxes and tire urns. Our budget needs had always been provided by private and corporate grants. However, one-year waiting lists for the vegetable garden program and requests for planting street trees and flower gardens, both beyond our staff and financial capabilities, seemed just the tip of an iceberg of community interest in gardening.

Convinced that community-supported public horticulture was a vital part of any urban rehabilitation effort, the Society applied to the City of Philadelphia's Of-

V. L. Beatty

The tired tire can end its days in beauty. As an inexpensive container it looks good, works well and recycles perfectly. It will protect plants on pavement, soil or balconies, and can be a good cooperative community project.

fice of Housing and Community Development who granted funds through its Community Sponsored Projects Division to help establish Philadelphia Green in March, 1978. Supplemented by foundation grants, the Society not only extended the level of its capabilities in working with the Philadelphia community, but also expanded the scope of its other services.

A staff of 10 full-time horticulturists and assistants currently works for Philadelphia Green and travels through the neighborhoods in two Society-owned vehicles, a window van and the highly visible Gardenmobile, a brightly-lettered step-van with painted vines crawling up onto the roof.

The Society works with a private landscape firm, which provides a foreman and two laborers. They perform major hauling, loading and the heavy physical labor that cannot be done by the residents. The landscape firm supplies the dump truck, tractor, loader and other equipment needed for the operation of the program.

Four Kinds of Gardening

Philadelphia Green offers assistance in four areas: vegetable gardens, sitting gardens, street-tree plantings, and window boxes and tire-urn plantings.

The Vegetable Garden Program provides groups with fencing, soil, tools, plants and seeds to grow their own produce—cabbage, lettuce, collards, tomatoes, okra, even cotton, sugar cane and peanuts. The community groups are responsible for putting up the fence, spreading the soil and fertilizer, and planting and maintaining their garden. Philadelphia Green staff is available to help with the planning, rototilling and planting, and to give technical assistance and workshops.

At least ten neighbors must agree to form a garden committee. They must have a vacant lot they want to use and get permission to garden on it. Because of the Society's funding sources, most gardens must be planted on publicly-held property or owned by a nonprofit entity. Private contributions allow Philadelphia Green to assist groups on private property.

The other "vacant lot" program is the Sitting Gardens Program, a new direction in community involvement for the Society. Sitting gardens are small lots where neighbors can grow and enjoy flowers, trees and shrubs. The staff coordinator for the program works very closely with groups to develop and carry out garden designs, unique to each community and its needs. The community must provide the volunteer labor for preparing, planting and maintaining the garden site. Philadelphia Green supplies the topsoil, organic matter, plant material, tools and fencing where needed.

Philadelphia Green's sitting gardens effort varies significantly from similar city-operated programs because the residents themselves actually do most of the work involved in building the park. Ten people must form a garden committee, choose a lot in their neighborhood, and obtain the lot owner's permission to use it. Because neighbors can inject their own ideas, designs and efforts into the project, and then bring them to fruition, there is enthusiasm, excitement and cooperation.

With both of the vacant-lot projects, the threat of vandalism is a cause for some concern. Our program provides only a five-foot turkey wire mesh fence; a few groups have raised money for a higher chain link fence. Vandalism, however, has not been a major problem. The gardens are located usually on the block, within the watchful eyes of several residents. Besides, so many people young and old cooperate in the care of the garden that pride and respect pervade the community. Everyone seems to be a member of an informal guard group.

The Street Tree Program provides technical assistance, trees and other materials to communities who are willing to support and cooperate in the planning, planting and maintenance of the trees. The Philadelphia Green crew removes the cement at the locations chosen by the residents and approved by the Fairmount Park Commission, which has jurisdiction over site selection and permits. The neighbors then must dig three-foot-square tree pits three feet deep. Several staff members work with groups of neighbors to plant, stake, guy, and wrap the trees, which are 12′ tall and balled and burlapped. Staff workshops then teach the new owners how to water and care for the trees until they are well established.

Up and down the street window boxes and tire urns mark almost every house with a burst of colorful flowers by midsummer. The object is mass effect and the impact is exciting. These sidewalk container gardens lining Philadelphia streets are a tradition. Louise Bush-Brown began the Neighborhood Garden Block Program in 1953, and more than 700 blocks have participated in spring plantings. Philadelphia Green provides the block with soil, annuals, and some hand tools for two years. Residents must make or buy their own containers.

Philadelphia Green staff is now helping residents to plant curbside permanent planters with evergreen shrubs. These planters are an alternative to trees for narrow streets. Our crew assembles the cinder-block planters, and the neighbors paint them, fill them with soil and organic matter, and plant them with hardy material such as yews and junipers. Annuals add color to the planters during the summer. Philadelphia Green staff instructs the residents on the care and maintenance of the plant material.

Planted window boxes and tire urns are effective when there are a lot of them; so Philadelphia Green requires that the whole community participate to make that program work. Petitions for both the street tree and garden block programs must be signed by 80% of the residents on the block to demonstrate this broad community support.

Scope and Philosophy

Some statistics show the scope of Philadelphia Green. In 1978, we worked with 55 groups who started vegetable gardens on lots averaging 3,000 square feet (since 1975, the Society has assisted more than 160 gardens get planted); 40 blocks planted window boxes and tire urns; 10 neighborhoods began sitting gardens; and 18 blocks planted their own street trees. The projects involved the voluntary efforts of a few thousand neighborhood people, and will affect thousands more.

Neighborhood support and cooperation is the foundation of our public horticulture philosophy. Petitions, workshops, basic minimal registration fees and "work days" all reinforce this responsibility by the community. In fact, it is the justification for the Society's involvement. We realize that an educational program cannot be effective without the apropriate teaching tools, plant materials and other supplies. Whether or not PHS continues as contractor for the public horticulture effort in Philadelphia over the long run, it will still continue to educate—to expose people to the pleasures and the physical and spiritual satisfaction of gardening. ☘

Photos: Peter Wotowiec

SCHOOL GARDENING IN CLEVELAND

More than horticulture is involved

Peter Wotowiec

Spurred by action of a group of dedicated garden club members, the school gardening program was established in the Cleveland public schools in 1904. Originally intended to create interest on the part of children in the art aspect of horticulture, the program has evolved over the years so that it now serves as a learning laboratory for the application of various academic skills in a real-life setting.

In Cleveland, school gardening has branched into several components. One component, Garden Science, serves all elementary school children through classroom lessons in basic horticultural science. Supported by short radio-program and cassette-tape lessons, teachers and children participate in activities which include making cuttings, potting plants, sowing seeds, identifying plants and planning vegetable gardens. Since learning by doing is most effective, each child is directly involved in these classroom gardening activities.

Home and Tract Gardens

The Home Gardening and Tract Gardening components are an extension of the classroom garden science instruction. Children who elect to participate pay a small fee to cover the cost of seeds, plants and other necessary supplies. Home gardeners select a garden appropriate to their age level and space available to them at home.

Pre-packaged kits of seeds, plants and supplies are distributed to the registered home gardeners through their schools. Under the direction of their parents or relatives, the gardens are planted and maintained. An adult member of the family evaluates the gardeners' progress and reports the results, which are maintained in a central file.

City children in particular respond to the pleasures of a garden while they acquire valuable experience related to their other schoolwork.

Children who live near one of the fifteen tract garden sites report on a regular schedule through the growing season. Under the direction of skilled teachers each youngster is provided with supplies, assigned an individual garden plot and then plants, maintains and harvests the crops which are taken home for family use.

Home and Tract gardeners participate in local school and city-wide garden exhibits, where they show their gardening achievements. Displays of vegetables and flower specimens, flower arrangements, various gardening crafts, essays and artistic gardening posters are a credit to the school gardeners and are an inspiration to both young and old. All gardeners completing a tract or home garden are annually awarded certificates of achievement.

Hundreds of young Cleveland school gardeners develop intense interest in horticulture and enroll in career preparation programs in high schools. Through dedicated study many graduates are now successfully employed in horticultural vocations.

Over the years, the success of the Cleveland school gardening program has provided many lessons in the value of educating children through gardening. School gardening is much more than simply learning how to raise vegetables and flowers. While those skills are certainly no detriment to any person, the greatest values accrue when gardening is integrated into the curriculum and becomes a living, child-centered, learning environment.

Children, especially those who live in the artificial concrete, steel and wood urban setting, tend to view the few bits of natural environment—such as grass and trees—as foreign elements. Surrounded by their man-made environment, they perceive themselves as masters of their surroundings. By snapping switches for light, turning faucets for water, and pushing buttons for elevators, they begin to think they can control, at will, whatever or whoever is around them. They are isolated from the natural world and do not realize they are subject to the natural phenomena which affect all living things.

A properly managed school gardening program can provide children with positive experiences with the natural environment. That, in turn, can provide a sound base for the development in the child of a realistic understanding of himself, his relationship with his environment, and with his fellow man.

As a learning laboratory a school garden can be very effective. Away from the confines of classroom walls, where learning sometimes seems meaningless, children in the garden must deal with the real world. To plant and maintain a garden, a child must determine some basic facts and develop necessary skills to accomplish the goals. The child is guided through those real-life processes in a step-by-step pattern. The need for information and skill is felt by the child and each step accomplished reinforces the need to proceed. The ultimate reward is in producing vegetables or flowers for personal or family use. Through careful planning and management a garden can provide valid learning experiences and success for children of all ages and ability levels.

To plant and maintain a garden, most of the classroom academic skills must be applied. Mathematics is used daily whether in measuring garden rows, spacing plants or in keeping records. Making a garden using metric measurements is a lot of fun for children—and a relatively smooth entry into metric concepts.

Science study in the classroom is often stimulated. In the garden, an understanding of weather has direct bearing. The interaction of different insects among themselves and with the crop plants is readily observed and becomes more meaningful. Communication skills, often boring routines in the classroom, are absorbed almost painlessly in the exciting garden environment. Reading instructions, describing a procedure to fellow gardeners, and writing about gardening experiences are a means to achieving a goal—not simply an end in themselves.

Longer-term Value

Among many other values is one which should not be overlooked. That value is in learning acceptable work habits and attitudes. For many urban children, the garden could be their first real "job." The need for starting on time, working at a reasonable pace, completing a job and cleaning up the site and tools becomes clearer when the child's own garden is involved. Good work habits and attitudes will be of value in whatever work the person will engage.

Every few years a movement fostering a return to the "basics" of education surfaces. There can be no argument with the need to adequately learn to read, write and compute. But one of the basic educational needs consistently overlooked in our sophisticated urban society is for human beings to live and work in concert with the natural environment. If in meeting that basic need we can bring about in children a more positive interaction with the natural environment while at the same time reinforcing their educational development, the lesson to us is clear. Gardening should be a part of the total education of every child. ☘

GARDEN PROGRAM IN JEOPARDY

The 75-year-old Cleveland school gardening program is a model that has given inspiration to many others around the country, including BBG's own Children's Garden. Despite its long history of success, the program's future is now in danger because of the financial problems of the City of Cleveland. Letters of support may be addressed to Mr. Peter Wotowiec, Supervisor, Horticultural Department, Cleveland Board of Education, 1380 East Sixth St., Cleveland, Ohio 44114. ☘

Several agencies cooperate to give . . .

A TASTE OF GARDENING—CHICAGO STYLE

Gregory R. Stack

Vegetable gardening conjures up all kinds of ideas in people's minds. One of the most common pictures of a vegetable garden shows large open areas of land with deep, fertile, dark-colored soils. All of this is then neatly arranged in a backyard setting.

Gardening has taken on a different look though, now that it has become one of the nation's most popular outdoor activities. Vegetable gardening is at its strongest point since Victory Garden days. The National Association for Gardening estimates that there are about 32 million gardens throughout the nation, yielding 16 billion pounds of vegetables with a retail value of $10 billion.

With such a high number of gardens being planted each year one wonders where they are located. Many of course are located in suburban settings, but an astonishing number can be found within the city. Inner-city gardens are on the increase and vary from several hundred square feet of space down to just a pot or bucket with a tomato or cucumber plant growing in it.

Gardening in Chicago

In Chicago, a large number of gardens occupy vacant lots, public transportation right-of-ways, open areas between buildings and containers on porches and balconies. These gardens are a refreshing change from lots cluttered with trash or weedy areas along railway cuts.

Gardening in Chicago is not a new idea. Many agencies, both public and private, have seen the value of gardening and have undertaken various programs to support it. The University of Illinois Cooperative Extension Service has played an active part in assisting city residents as well as all of Cook County to gain more from their gardening experience. The federal government itself has made available to Chicago and other major cities funds to assist in urban gardens for food production.

The Urban Gardening for Food Production Program, under the direction of the University of Illinois Extension Service, is a pilot effort to help people develop well-planned vegetable gardens as an aid in family diet, with both fresh and processed produce. The program also helps individuals and groups locate needed resources so they can garden effectively. The major participants are families with limited incomes.

The Urban Gardening Program operates in three major areas of the city. Each area is overseen by an extension horticulturist. To be more effective in the local community, program assistants from the community are also employed. They provide community support, locate sites for gardens and serve as teachers. The assistants are also responsible for the establishment and maintenance of demonstration gardens in the area where they are working. Through the demonstration gardens, which act as outdoor classrooms, new ideas are constantly presented. The gardens are planted with different kinds and cultivars of vegetables, and using different planting methods. For example, wide-row planting and vertical horticulture are exhibited. There are twenty-one such gardens, each with its own "personality." Vegetable items may sometimes reflect an ethnic choice. Each garden demonstrates how to use limited garden space well and at the same time grow high-quality produce under trying conditions.

Where in the City Is There Room to Garden?

When you look around and notice how close buildings are to one another and how much area is paved, there seems to be none. But, as was found out during this first year, space is there; it just may not be the ideal. Vacant lots are the first choice of sites. One has to remember that upon a lot once stood a building. But

V.L. Beatty

Showing and sharing is great fun, such as here at the First Chicago Housing Authority Resident's Garden Committee Harvest Festival.

where is the building? In many cases during garden site preparation the building was found about three inches below the ground. A number of lots were found to be suitable but still had much rubble to clear away. Adaptation is a key word in urban gardening. In many cases the brick and concrete were used to outline garden plots and walks, and they look rather nice as a garden edging. Large pieces of concrete were used to mark corners and mend holes in fences. Wire and reinforcing rod that "sprung up" in some gardens were a help to some gardeners. The wire was used to support pole beans or make tomato stakes.

Other Gardens

Public transportation right-of-ways such as the Chicago Transit Authority elevated tracks were also used as garden sites. Surprisingly, these areas are quite acceptable. In spite of having heavy weed growth, they are generally free of buried debris and have soils which offer promise for gardening. Because of the shade cast by the tracks, interesting effects could be noted. In some cases crops were stunted right up to the line of shade while those in the sun grew normally. This provides ideas for future planting—by selecting more shade-tolerant vegetables and arranging rows so each plot receives the most sun possible.

Many gardens were planted in cooperation with the Chicago Housing Authority. In some of these housing developments the population can reach as high as 22,000 residents in apartment complexes covering 92 acres. Under such high-density conditions gardening becomes an important part of family life, offering a form of recreation, providing green space and instilling a sense of community pride.

The Urban Gardening Staff, with the Housing Authority, helped residents start new gardens as well as improve older ones. In many cases the gardens were a community type that allowed people to grow plants in the same spot. In some developments, the backyard adjacent to an apartment was planted totally with vegetables. The apartments in these areas joined a common walkway. Having gardens on both sides of the walk made a nice sight because most of them were well tended and had a personal touch, especially when it came to fencing. Fencing was mostly commercial wire or wood but a few people did a great deal of work in constructing fences woven with heavy rope.

The survival rate of gardens planted in such highly populated areas is quite high. The program assistants were instrumental in getting community involvement. When such involvement exists, everyone has a part in the garden and vandalism seems to go down. Several of the program assistants have gotten a number of youths involved in gardening. A change of attitude seems to occur in those young people who have their own gardens. By having an area they can call their own, a sense of pride is taken in their garden as well as respect for other gardens. This past summer some of the finest radishes and cucumbers came out of a garden plot adjacent to a C.H.A. rowhouse. The garden was grown and tended by a 10-year-old boy.

Senior citizens are very active gardeners. The Urban Gardening Staff had the opportunity to start gardening programs in several nursing homes in Chicago. Not only were small garden plots prepared but also container gardens were planted. This afforded the fun of growing for those who couldn't tend larger plots.

Teaching—the On-going Contact

As was mentioned, teaching is a major aspect of the urban gardening program. Area horticulturists are involved in weekly updating and teaching sessions for the program assistants. At these sessions the assistants are brought up to date on garden problems to look for as well as cultural practices to follow. The assistants are also involved in a teaching role. They often meet on a one-to-one basis in the garden or at a community center for educational sessions. Having a professional horticulturist in a local area gave all residents of the area a chance to have questions answered expeditiously.

The success and benefits of gardens can be seen in a number of the areas where gardens have been established. Neighborhoods take on a different look. Parkways are soon planted with grass or flowers. Fences get repaired and painted. Vacant lots, once weed-grown and littered with trash, become attractive. Spinoffs such as these can be seen as a result of the magic of gardening. Another benefit is social. People talk to one another more, visit more and share more. Many of the gardens that were planted made available extra produce to halfway houses, association houses and senior citizens buildings.

A comment appearing on an Urban Gardening Participation form sums up the feeling many urban gardeners have: "I would very much like my own small patch of dirt to get dirty in and grow things."

GARDENS FOR ALL

As readers may gather, a number of local groups around the country are committed to community gardening. There is a similar-minded nonprofit membership organization called Gardens for All—the National Association for Gardening, which is located in Vermont. It has demonstration gardens, issues a quarterly newsletter, and is the publisher of several books on community gardening. For particulars write Gardens for All, Box 90013, 180 Flynn Ave., Burlington, VT 05401.

Experience from the heartland . . .

A COMMUNITY GARDEN IN KANSAS

Lisa Barnes

Community gardens are initiated and organized through various organizations and individuals. Some are established through federally funded programs, others from the community in which they are planted.

"Free universities" serve as clearinghouses for informal educational opportunities, also as stimuli for the development of community-based programs and organizations. University For Man is a "free university" operating through the Continuing Education division of Kansas State University in Manhattan, Kansas. University For Man began a community gardening program in 1974 with a $4,000 grant from ACTION for the part-time salary of a coordinator.

A Contract

The garden plots, approximately 20′ x 20′, increased from eight in 1974 to more than 120 in 1978. The two acres of land devoted to the plots are leased on an annual contract basis from the City of Manhattan and renewed with annual reports to the City Commission. The land for the gardens is located in the Community Development section of Manhattan and is designated as "green space," which means that it cannot be built on for twenty years. The two acres are beside a railroad track, which also makes building undesirable. If this land were not used for garden plots, the city would have to maintain and mow the area, which would be an additional expense to the municipality.

The neighborhood in which the gardens are located is a part of Manhattan where the majority of families are "low income." A contract with the city specifies that the majority of the gardeners should be low income in accordance with Manhattan guidelines: "Families of four or less persons earning 80 percent or less of the median income for the city," which is $8,400 and $600 per additional person. Of the 100 gardeners in the 1978 season 70 percent were considered "low income" under these guidelines. Gardeners pay a minimum fee of $7 per plot, with increasing fees for higher incomes. The fees are used to provide water, hoses, tools, custom tilling and other items such as insurance. The greatest cost is for water.

After the first-year grant from ACTION, the gardens have been financially self-sufficient. The coordination of the gardens is a volunteer position. It is truly a learning experience for the volunteer.

Organization

Since the organizational base for the community gardens is a free university, one of the focuses in the development of the gardens has been in education of both the community gardeners and the Manhattan community. Once the application process is completed in February, gardeners are informed by letter of a general meeting. At this, they have the opportunity to meet each other, pay their fees and find out where their plots are located. This meeting is also used to distribute gardening information provided by the Cooperative Extension Service. The gardeners typically begin their sharing of information and experiences at this time, with some of them arranging with each other for cooperative seed orders and exchanges. Patrols are organized to report to the coordinator gardens that are not maintained or where potential problems may develop.

A biweekly newsletter is sent to all gardeners. It contains tips on gardening, current problems and notes from gardeners to each other. Examples might include an article by one of the gardeners on edible weeds or a list of vegetables to trade. The newsletter serves as an educational resource and a social mechanism for the participants to communicate with each other. It also helps maintain interest in gardening, which otherwise tends to dissipate as the weather gets hotter.

Photos: Lisa Barnes

The community gardens in Manhattan are near many of the lower income people for whom they were intended.

Entire families pitch in to share the responsibility and reward of the plot.

Several gardening classes are taught in the spring and summer through University For Man. An early-spring class on vegetable gardening emphasizes planning to get maximum yield. A summer class discusses fall vegetable gardening. Other classes include canning and preserving, insect identification, drying foods and children's gardening. These classes are free of charge and open to the general public. Kansas State University staff and students teach them.

Also for Children

The children's project provides young people ages five to twelve with their own plots and a group gardening experience. They learn how to plant flowers and vegetables and expend their energy on their own plots. Small plots (3′ x 5′) are set aside for all interested children. Each plot is identified with his or her name and is marked off with string tied to wood stakes. Also, instruction and seeds are provided. The children meet each Saturday morning to organize activities, work in their plots and harvest produce. They develop an intense pride in their own vegetables and flowers, gardening from early April to late October. A playground area complete with a sand box has also been constructed for younger children.

The Manhattan Men's Gardening Club built two cold frames on the community gardens land as a service project. Each year its members plant tomato, broccoli and cauliflower seeds in the cold frames and provide free plants to the gardeners. A plant exchange is offered each spring so gardeners may exchange plants they have started inside.

Several studies have indicated that the people who use community gardens are usually inexperienced gardeners; therefore, providing the opportunity for learning is an important aspect of programming for the community garden coordinator. ✤

Rewards but an uncertain future at . . .

SPARTAN GARDENS IN MICHIGAN

J. Lee Taylor

Spartan Gardens is a community garden project that was started near the end of World War II in East Lansing, Michigan. The project apparently grew out of the Victory Garden era and continued at a fairly restricted level of interest until the early 1960's, when it grew from around forty plots to 500 or so in the mid-1970's. The project has normally been coordinated by faculty or graduate students in the Department of Horticulture at Michigan State University. The majority of gardeners have been MSU faculty, staff and graduate students who do not have enough space at home to garden. The location of the gardens has changed several times but has usually been within a four-mile radius of the MSU campus.

How It Works

Original plot size was 50′ x 50′, which was reduced to 25′ x 50′ ten years ago when site spaces became limited due to increased demand. It was found that most gardeners didn't need or want to care for the larger plots.

The rental per plot around 1960 was $7, which included fertilizer, plowing and discing. The rental for a plot in 1978 was $18 and included plowing, fitting, staking and availability of water.

Perennial plants usually could not be grown since gardeners often didn't know which plot they would have the following year even if the gardens were to be located at the same site. Perennial plants would also prevent plowing and fitting in "nice" rectangular patterns so often associated with community gardens in the United States. Gardeners at the most recent site were able to have a long-term lease so that they could put in perennials. They had to work the ground on their own, however, after the first year.

One of the problems has been the lack of access to water. Most sites never had water so each person would have to haul his own to his plot. Two shallow wells were established at one site which worked reasonably well except for the fact that someone always needed to leave some water at each hand pump in order to prime it, and precautions needed to be taken to keep children from drinking it. Another problem was the lack of physical improvements to a site because a site was usually made available for just one year. Therefore, improvements made one year might not be realized the following year if the site moved. Another problem associated with changing sites was the usual thick stand of quackgrass and other weeds usually present at the new site. Freshly worked soil looks very appealing the first few weeks after being worked up in the spring, but quackgrass and other weeds eventually appear and dominate many plots unless extensive control measures are taken. A small portion of the land at one site was made available for "organic" gardeners. Quackgrass was also their major problem.

Information supplied to gardeners varied each year from virtually nothing to the thorough distribution of extension bulletins and other written materials, and the holding of garden workshops. Seeds and plants were occasionally offered for sale to gardeners.

The popularity of Spartan Gardens and gardening in general has stimulated the offering of small garden plots for rent by several private individuals in the area. In many cases, churches, apartments and other organizations started community gardens which were closer to the gardener's home and were leased.

A survey of participants in the 1967 program indicated the following: 43 percent of those renting a plot shared their plot with at least one other family and some with as many as five others; most

Photos: USDA/William E. Carnahan

Transplanting America's favorite garden vegetable.

traveled 3 to 6 miles to the garden, half would not travel further than the 3 to 6 miles, but one-third would be willing to travel up to 10 miles, and 16 percent would be willing, if necessary, to go 20 miles to have a garden; trips to the garden and time spent there could be split evenly in three groups; one-third made one trip a week and spent an hour there; another third made two trips and spent 2-3 hours there; and the remaining third made 3-4 trips and spent 4-6 hours here; approximately one-third of the participants had not gardened before, and the main reason for gardening was for recreation, with economic, educational and higher-quality vegetables all tied for second reasons.

Several years ago, one graduate student who had been involved in the coordination of the project purchased some acreage six miles north of East Lansing and moved the Spartan Gardens project to that site. Water was made available to gardeners and plot size remained 25′ x 50′ about 160 individuals gardened there last year.

An Uncertain Future

Efforts to have the Spartan Gardens project situated on the campus of Michigan State University have proven futile. Originally, it was felt that university property couldn't properly be used for such purposes. Later, administrative officials were reluctant to press for such a move since the acreage required would have to be taken from that already allotted to the various departments of the University. Second, the source of funding to establish and maintain the program could not be located. Another reason was the concern that the site might be located adjacent to plant research plots where it would be more difficult to keep visitors, children and others from picking fruits and vegetables. The university's obligations for security and liability were also posed as possible stumbling blocks.

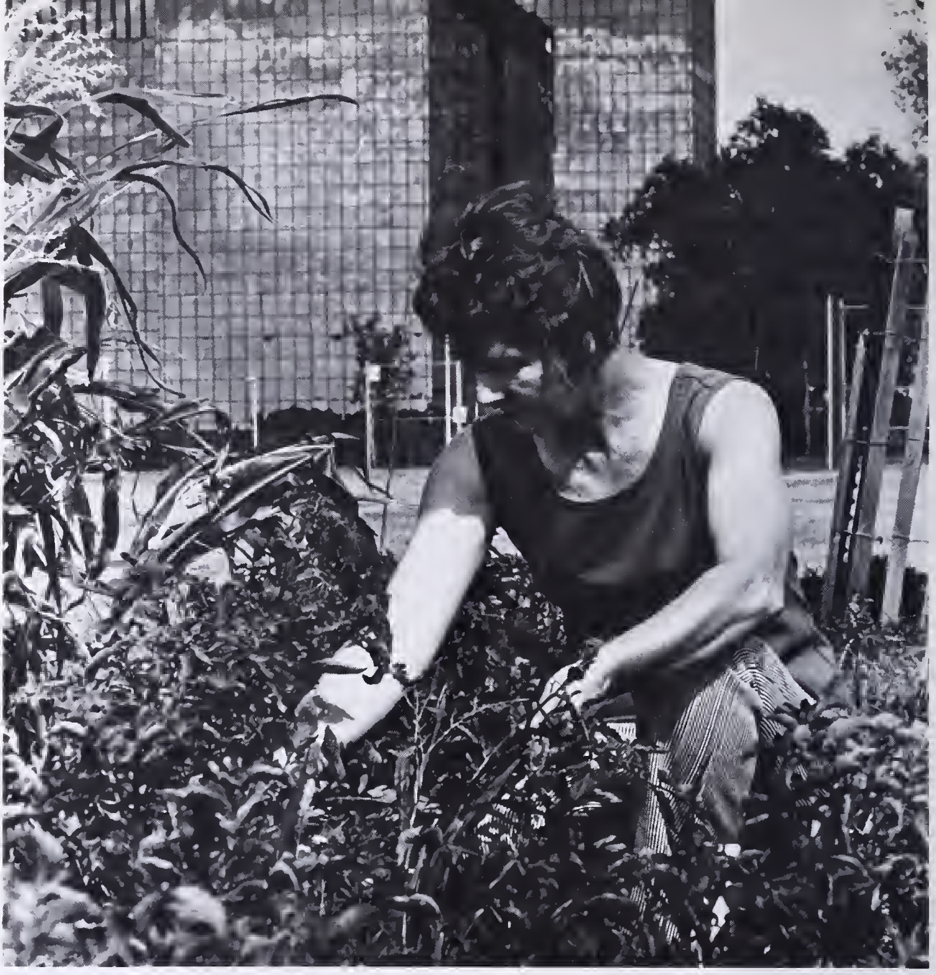
About six years ago, one group was successful in getting some plots on campus. Residents of university apartments belong to an organization that has been successful in operating a community garden project. About 170 plots (25′ x 25′) were rented last year—the maximum that can be rented at the site.

The future of Spartan Gardens is unclear at this time. Only one graduate student worked with the program last year and he will graduate before this year's program is underway. In addition, the land where the gardens were located is for sale, and last year's coordinator has no obligation to find a new site since he will not be involved in this year's program. The East Lansing Recreation Commission has been notified of the status of the project in case they have any interest in becoming involved in a community garden program. These are just some of the typical problems associated with community garden programs.

General recommendations for an "ideal" community garden include having a permanent site; continuity from year to year in personnel who coordinate the project; having the site close to homes of participants; access to water; ample parking; and a playground for children.

Gardener reaction to the Spartan Gardens project has been unusually complimentary. In a survey taken at the close of the gardening season several years ago, this typical comment was made: "Gardening here at MSU has been one of our most memorable experiences. It is so seldom that we are able to get out from under the books, and this diversion is ideal. Both my wife and I enjoy working in the soil and watching things grow. All in all, it was a most rewarding experience."

Black plastic sheeting, an excellent solution when weeds are a problem, also helps retain ground moisture and warmth in spring.



EMPLOYEE GARDENING AT CONTROL DATA CORPORATION

Ted Tonkinson

Growing your own garden vegetables can be difficult if you don't have the proper space or conditions at home, but this is no longer a problem for employees of Control Data Corporation in Minnesota's Twin Cities metropolitan area. For the last five years the company has made available to its employees a 5.7 acre plot of land at the world headquarters building for a gardening program that has met with enthusiastic response.

Over 1,000 employees currently participate, and they are finding the program both productive and fun. Gardens also are made available to retired employees who live in housing without gardens.

The initial planning and logistics are handled by the corporate staff, with the assistance of a part-time horticulture student from the University of Minnesota.

Planning begins early. Notices are sent

Ann Wysocki, above, a quality assurance inspector, tends her garden at corporate headquarters in Bloomington, Minn.

in April to the various facilities in the Minneapolis-St. Paul area announcing the date that plots will become available. Employees may select either a single plot (10′ x 15′) or a double plot (10′ x 30′), and as registrations are received, plots are assigned on a master chart.

Cultural information is supplied initially to employees at luncheon seminars conducted by local experts, but once the program is underway, individuals find they can solve their own problems by consulting the Agricultural Extension Service or fellow gardeners. The University of Minnesota Department of Horticultural Science and Landscape Architecture maintains a telephone clinic to assist individuals with specific problems, and provides free literature on crops.

Water service is provided by Control Data at the garden sites but individuals provide their own labor and equipment for periodic irrigation. General fertilizer is applied each spring according to recommendations based on soil tests. Pest control and cropping techniques are all individual choices.

After the fall frost ends gardening activities, the area is plowed and disced. Employees are contacted and encouraged to send suggestions for improvement of the program. Efforts are made the following year to remedy any problems such as areas with poor soil conditions or low spots with standing water.

Each August, all gardens are judged for neatness and vegetable quality, and the winner is presented with the Golden Hoe award. A photograph of the winner and an accompanying article is published in the employee news magazine which is circulated to Control Data's 51,500 employees throughout the world.

Control Data Corporation is committed to expanding this employee gardening program to its other facilities as conditions permit. In addition, the company is reviewing the potential of unused land and resources in the urban environment for production of specialty crops. ⁂

Photos: Control Data Corp.

Chris Jackson (center), a first-time gardener, was named winner of the Golden Hoe Award from among one thousand Control Data Corporation employees participating in a larger community garden project.

Community gardening . . .

IN MINNESOTA

Jane P. McKinnon

Community gardens in Minnesota are not outdoor clubrooms and certainly not replication plots for scientific vegetable culture. After several years of experience, Agricultural Extension horticulturists and municipal park officials have concluded that community gardens are enjoyed for solitary or family activity, a refuge to do almost as one pleases, a setting for quiet recreation.

Many Minnesotans have close ties to agricultural pursuits and an intimate acquaintance with the out-of-doors. They may begin a garden with ideas of saving money on their food budgets, but most continue for the pleasure of the rewarding association with soil and sun, or remembering their farm beginnings, or the new discovery of the miracle from seed to fruit. Most Minnesotans using garden plots expect initial soil preparation, available water, help with intruders such as a foraging ringneck pheasant—and then to be left alone.

The growing season jumps to a start in Minnesota. March snows, April melts and rains, but one morning there will be bare ground dry enough to support a tiller. The time clock begins to run, and hours are all too short between the first turned earth and the frosted crust around old radishes in late fall.

Community Programs

St. Paul, Minnesota's capital, is part of a metropolitan area with Minneapolis and many suburban cities and villages. These communities are located in several counties. Ramsey County is totally urban. St. Paul is the largest municipality, ringed by White Bear Lake, Maplewood, Shoreview, Roseville, Arden Hills, Mounds View and other areas whose names suggest the surviving character of the region. Shoreview has shores, White Bear is a large lake, and from Mounds View one can see the Minneapolis skyline. Most Minnesotans feel drawn out-of-doors, and many tend plants. Three-fourths of the households in this metropolitan area garden to some degree. About 43 percent of this activity includes vegetable growing.

Community gardeners pay $5.00 a season to rent each plot. Some families reserve two plots; no more are allowed. For this sum, gardens are tilled in the spring, and plots are staked, marked and parceled out to the renters. This is no easy task. Some people want the "same plot I had last year," others request the space used by a better gardener the year before. In some years sponsoring agencies fertilize plots when tilling, but usually fertilizers are the responsibility of each gardener. Plot sizes vary from 15′ x 15′ in one site, used mostly by older gardeners, to 25′ x 25′ in a community garden with considerable space.

The Ramsey County Extension Service began managing community gardens in 1972 on sites left vacant because of urban renewal. By 1974, the program expanded to suburban parkland with 500 15′ x 20′ plots opened to the public. In 1978, 850 plots were managed at four different sites. Approximately 500 gardeners worked through a very hot, humid and rainy summer to harvest crops valued between $20 and $70.

The Parks Department of Arden Hills has had four years' experience with two sites. Sixty percent of those people signing up for space each year are repeat gardeners. The only service after the first soil preparation is delivery of water by city trucks to barrels at the sites. No supervision is provided. Gardeners receive the newsletter from the County Agricultural Extension Office and are invited to meetings with Extension horticulturists.

Maplewood's Parks and Recreation staff oversees 100 garden plots on an old farm used as a community center. Plots are rented in April, offered first to Maplewood citizens and then to anyone who asks for remaining space. Renters are responsible for maintaining a weed-free garden. This provision is included at all the community sites, but enforcement is difficult. Water in Maplewood is pro-

Good community garden organization has elicited an enthusiastic response from Minnesotans.

Photos: Jane McKinnon

vided from a spigot, to be carried in buckets or sprinkling cans to each plot.

Mounds View began community gardening last year. Over 35 percent of the town's population lives in mobile homes. The parks manager was surprised that not all of the 100 garden spaces were rented, despite publicity from newspapers, bulletin boards and organization announcements. Water had to be carried from across a street, but it was furnished free by the city. One explanation for left-over plots may be that many of the town's home sites are approximately a half-acre, enough land in many instances for private gardens. Some gardeners who did rent space lived on heavily wooded properties and needed land in open sun, a prerequisite for a successful vegetable garden.

Problems and Rewards

Problems experienced by sponsoring agencies include the expected differences in interest and skill of renters. All community garden agreements include promises to keep plots weed-free, plants confined to individual boundaries, and left-over plants and debris cleaned up in the fall. No herbicides are allowed, but there is usually some disagreement among gardeners about whether one person's insecticide dust for tomatoes floats to another's beans! Sunflowers and sweet corn, so popular in the Midwest, shade adjacent rows. Where water is supplied in barrels, gardeners sometimes complain that after-five workers have none to use. Soil conditions, locations of sites, occasional pilfering or the need for tall fences are subjects for complaint. The modest $5 fee offers no possibility of paying for additional services. Agricultural Extension Staff members have been surprised that more gardeners did not use their opportunities for horticultural education. Services expected from sponsoring agencies are neither cheap nor easy. Preparing and renting the 850 plots managed by the Extension Office uses at least a month's time of two staff members.

Minnesota's community gardening brings rewards as well. One city official counts the positive effect of having residents come to his office for a pleasant service rather than a property tax argument, complaints about snow-filled streets or plugged storm drains. With community gardening, city recreation opportunities are provided for people who cannot skate, ski or play baseball. The Ramsey County Extension Office treasures a letter from a father who said the garden brought him and his son together, another from an older person who said his plot kept him alive, and a third who counted the summer as a religious experience. Office work, telephone interruptions, calls for protection from rabbits and groundhogs, posting bulletin boards and checking empty water barrels seems not too much to do when gardeners share vegetables and experiences to make urban living wholesome and productive. ❧

PROS AND CONS OF A MUNICIPALLY OPERATED COMMUNITY GARDEN PROGRAM

Adapted from *Community Gardening Handbook*, Hunger Action Center, Evergreen State College, Olympia, WA

The disadvantages of a municipally sponsored community garden program are those which are often involved in operating any program within a complex bureaucracy, such as extended time frames to accomplish projects and inflexibility due to standard operating procedures, combined with large amounts of required paperwork. The other significant disadvantage is the dependency on a city council for continued yearly funding.

The advantages are also significant in providing ready accessibility to necessary services and resources, which in some cases are not available to any other sponsoring agency, and the sanction and credibility afforded to the program by the community. There is also merit in the institutionalization of a community garden program through a local government to insure its continued effective and stabilized operation. The connection of the program to elected city officials can be very effective politically if the program has strong community support. ❧

Barbara Shaluchia

GARDEN HILLTOP IN INDIANA

Barbara Shalucha

Garden Hilltop, in Bloomington, Indiana, is now on the threshold of its fourth decade of service. It has involved over five thousand boys and girls, ages nine through fourteen years, and, in its leadership training programs, more than one thousand student-instructors. It receives the continuing support of the Indiana University Department of Biology, the Bloomington Department of Parks and Recreation and the Bloomington Garden Club.

Hilltop is a university-based science education project, demonstration center and outdoor laboratory for the biology department. It is also a leadership training center where the university student stakes out a claim in the future. Most of all, Hilltop helps boys and girls who love the out of doors learn to work with nature in a garden setting. When Hilltoppers are at work, they are involved with all the elements of the world around them.

Hilltop boys and girls and their leaders-in-training learn the art and science of growing plants. There are some ninety plots 9′ x 9′ for vegetables. Two 4′-wide walks intersect at the middle of the 1/4-acre vegetable garden, which is laid out like a giant checkerboard. Straw covers the 2′-wide side paths circling all the plots. The straw keeps the ground cool and moist and makes it easier to move between the paths, too. Fourteen kinds of vegetables are grown in each plot.

There are other small gardens at Hilltop, including ones for herbs, flowers and roses, as well as a garden pool and a natural area near it containing ferns, iris, joe-pye weed and purple loosestrife. In addition, there is a gardenhouse, which serves as a classroom, laboratory, library, office and toolroom. It is a nice place for working—orderly and restful, and alive with color and ideas. West of it, in a deeply shaded spot, is the council ring, a miniature amphitheater where Hilltoppers share knowledge, skills, ideas, and laughter and songs as well. Summer lessons in nature, plant development and nutritional education are given here. There are also a greenhouse and coldframe for starting certain kinds of vegetables early.

At season's end, Garden Hilltop represents many viewpoints. The artisan relates it to a center of gardening arts. The scientist conceives of it as a complex of garden ecosystems, a disciplined environment where youth begins to understand biological concepts, ecological principles and conservation of natural resources. In this outdoor classroom there is not only an opportunity for youth to find answers to some of life's questions but also to learn industry and patience, something about man's relation to his environment and a reverence for life. ⁂

On their way back from the back forty, youngsters at Garden Hilltop (above) are laden with the vegetables they grew themselves.

ON UNDEVELOPED PARK LAND

John Dotter

When the California Council for Community Gardening, the nation's first regional association of its kind, was founded in 1978, organizing members agreed that "Community gardening improves the quality of life for all people by: beautifying neighborhoods; stimulating social inter-action; producing nutritious food; encouraging self-reliance; conserving resources; and creating opportunities for recreation and education."

Cooperative development of gardens is a natural growth of people working together on behalf of these principles. There are abundant resources to support urban gardening programs in California, and as elsewhere the greatest underutilized resource is that of experienced gardeners. For a garden to be developed and operated by the "community," however, the community must be fully involved in the process.

The concept of community gardening is an old one, but the existence of programs for it within a recreation setting is new. In California now, community gardening has statutory recognition as a form of recreation eligible for local, state and federal funding. It has a growing appeal for young and old, and even those who are not for the most part joiners can be found sharing their experiences, tools and plants in a community garden. Such spontaneous exchange builds "community," and a wide range of social services is provided in a well-developed community garden at low cost. In fact, people can create these gardens with minimal assistance from the agency which is willing to make undeveloped park land available for this purpose. Most cities have such land, and it frequently offers more promising sites for community gardens than vacant lots, which may be shaded, be in congested areas, or contain building rubble.

Organization and Management

A full-time coordinator employed by a Parks and Recreation Department can provide technical assistance, encourage community involvement and give direction to volunteer efforts. There must of course be adequate community interest to warrant a program. The choice of a particular site within park land for a garden is important, too, not only for horticultural reasons but because of the people living nearby whom it will serve.

The careful selection of a volunteer acting garden manager is essential. He or she should be patient, flexible, get along well with people and provide a sense of "community" in the garden. He should also have a genuine love of gardening. These qualities are more important than horticultural expertise, for technical help can be provided by the coordinator.

It is important to determine the level of experience of people interested in obtaining garden plots. Some guidance apart from that routinely given by the coordinator and manager is desirable. Ongoing educational programs such as special-interest classes, assistance in tool selection, informational handouts and newsletters all help. As their experience grows, plot-holders gradually accept responsibility for maintenance of the "commons" or public areas of the garden. Monthly meetings of all plot-holders are also recommended, for success depends on involvement and the exchange of information. If there is a community gardening coordinator for several gardens in the area, he should be encouraged to attend the meetings when possible.

The general operation of community gardens is facilitated if there is a current listing of urban gardening projects in the local county, a file of project needs, and a knowledge of resources to turn to when help is needed. The coordinator can profit by frequent visits to other garden projects in the county and attend major conferences, meetings and workshops in urban gardening. The information obtained in

Photos: Joan Powers/Earl Dotter

Serapio Gomez, 77, gardener, beekeeper and Volunteer Community Gardener, Santa Clara County, California.

Abel Ricardez and two of his sons in their Mi Tierra Community Garden Plot, San Jose, California.

this way about available resources (free materials, employment opportunities, new techniques and skilled persons) can be shared for the benefit of those sincerely interested in the growth of community gardens. When there are strong regional networks composed of industrious persons cultivating a sense of community as well as the soil, then a national urban gardening information clearinghouse can become a viable mechanism for the transfer of information to local projects.

The urban gardening vision is a promising one which grows through the synergy of plants and people in a cultivated relationship. Harmony with the people and plants that constitute our everyday circumstance is a goal that deserves serious consideration. According to Bruce Stokes of the Worldwatch Institute, "Weeding and hoeing side by side brings many neighbors together for the first time. They develop a spirit of cooperation and community pride that carries over into other activities." Al Harris, program leader of the New York City Gardening Program, sums up the attitude of many community garden organizers: "We not only grow vegetables, we grow hope."

Saving time and energy . . .

RESOURCE CONSERVATION IN GARDENING

R. E. Gomez and D. J. Cotter

Gardening can be a relaxing and rewarding pastime. To maximize benefits gardens, whether they are community or home ones, should be productive, and gardeners should use the tools of gardening, including chemicals, wisely. This article is written to provide guidelines for people wishing to use a minimum amount of resources.

One cardinal rule is to grow the most productive vegetables and adapted named varieties (cultivars) of each kind. Vegetables with a high yield include tomatoes, beets, bell peppers, green onions, spring lettuce and squash. There is no excuse for planting poor seed or unadapted cultivars because of their nostalgic names. Neither offers good possibilities for success and growing them becomes a waste of time and energy.

Gardeners should consider blending economic plants into the landscape. This may be as important in community gardens as home ones, for space which is usually at a premium ought to be used attractively as well as productively. Many food or condiment plants can substitute for decorative ones in the landscape. For example, small fruit or nut trees can be used in place of large-growing shade trees, which in any case might reduce the good light that is essential for most vegetable crops. In particular, dwarf fruit trees closely planted and properly pruned make excellent hedges. Grape vines become good shade arbors or sight screens at the same time they are producing fruit. Fruits and vegetables planted in the flower garden can provide important decorative accents. Red- or green-leaf lettuces, yellow- or red-podded peppers, colorful gourds and red basil, cabbage and Swiss chard (including the red-stemmed rhubarb chard) are crops with potential. In mild areas fall-planted cole crops such as kale and cabbage have an attractive blue-green color in winter. Asparagus, rhubarb and other perennial vegetables can be used along fences or as background. Staking vegetables in a row to form a fence or a sight barrier will achieve a double purpose.

Resource-saving Techniques

Mulches conserve water and nutrients. Rolls of black plastic, available from garden-supply stores, raise the soil temperature 5 or 10° F, accelerate plant growth, and increase yields as well as early production. In addition, plastic reduces water evaporation and nutrient leaching. It also can limit certain insects and weeds. (Clear plastic can raise the soil temperature from 10 to 20° F, but weed growth underneath it is usually a serious problem.) Organic materials such as bark, corn cobs, wood chips, hay, sawdust, straw, leaves or compost, when applied as a 2-3 inch layer to a weed-free surface, can offer similar benefits. The application of organic mulches should be delayed until the soil warms up in spring and after seedlings have emerged.

Soils in community gardens often have poor structure. The incorporation of compost, which also has a certain amount of nutrients, is an efficient way to improve it. Compost is an efficient means of fertilizing the garden. A typical compost pile begins with a layer of six inches of chopped organic matter, one inch of soil, plus additional nitrogen to aid in decomposition. This layering pattern is then repeated until the pile is 4-5 feet high. The pile should be moistened and kept moist (not soggy) and stirred occasionally after the micro-organisms begin their work. The compost is ready to apply to the garden anywhere from several months to a year later, depending on the rate of decomposition in your climate.

In regions where the soil is acid (generally east of the Mississippi and in high-rainfall areas of the West), it may be necessary to add lime as well as fertilizer to the composting mix. A suggested guideline is to add 2 lbs. of finely ground limestone to every 100 lbs. of dry organic material used in the compost. Manure can be an important source of organic matter as well as adding some nitrogen. Its use, however, can cause a fly problem, and in some areas the salt content is so high as to be potentially toxic.

Of all the essential growth factors, water is the one that most often affects productivity. Increased organic-matter content of the garden soil aids greatly in water retention and reduces plant stresses due to water deficiencies. Such techniques as mulching and planting the garden behind a windbreak can also result in water savings. Even in high-rainfall regions, timely applications of water are necessary to minimize stress. The most common irrigating methods include sprinkler, drip or furrow systems. In choosing the system consider the size of the garden and the area of the country. Other factors to consider are: the amount of water available, initial costs of the system, the cost of water, quality of water, efficiency of the system and the need for supplemental water. If sprinklers are used, apply the water when evaporation is not too high such as in the early morning, and stop irrigating soon enough so the foliage dries before evening. Crusting of the soil may occur with sprinkling. If this is the case, then break the crust with a spring-toned rake. A "nailboard" can help seedlings emergence. Furrow and drip systems avoid foliage wetting, but the furrow system is often wasteful of water and can leach nutrients. The newer drip systems have the added advantage of using less water, leach smaller amounts of nutrients and can result in higher crop yields.

In each case the gardener should know how much water is applied. If the water is sprinkled on, old tin cans placed in the garden will give an indication of its distribution and the depth of water applied. If the water system is metered, the amount applied by a furrow or drip system can be monitored. A one-inch application can be determined by dividing the gallons applied per thousand square feet of garden by 625. Generally, an irrigation should consist of 1½-2″ of water. While the frequency is dependent upon the rainfall, during periods of dry weather weekly applications will normally be enough.

USDA/William E. Carnahan

Composting corn stalks for next year's garden recycles nutrients.

Fertilizers should be used wisely and in amounts sufficient to insure optimum yields. However, there are ways to minimize quantities. Applying fertilizers, particularly phosphorus, in a band is an efficient, non-wasteful method. Timing of the fertilizer application is important. Although detailed amounts differ according to the various locales, the following guide may be helpful: apply one pound of nitrogen per thousand square feet as a preplant application and sufficient side-dressing applications to give 3 pounds to each crop over the entire season. Also apply 4 pounds of phosphorus per thousand square feet as a preplant broadcast application and work into the top 6-8″. Use half the amount in a band, below and to the side of the crop row. Potassium is needed in the humid areas of the United States, but in arid parts little or none is required.

Pest Control

Pest control is a topic which has received much public attention. One important aspect is to provide an environment which encourages healthy crop growth. Plants which have adequate amounts of phosphorus and potassium grow well and resist diseases and moisture stresses. Control of weed pests which are often a source of insects or diseases is beneficial. Weeds are an excellent source of composting material if they are not allowed to reach the seed stage.

Rodent control offers special problems. Sanitation and cleaning up plant refuse reduces the places where rodents can hide and helps in the control of mice and rats. Fencing is an effective means for excluding rabbits and pets. Nematodes can be reduced by the additions of fresh organic matter to the soil at yearly intervals or by planting with marigolds. Neither technique gives immediate results, but both have been shown to work over a period of time.

Often it is possible to wash away insects with a hose or spray. In one case a solution containing a special coconut-oil-based detergent has been shown to be effective. The use of "trap" or "repellent" crops can be used effectively, but they also utilize the nutrients and water. It may be better to grow vegetables in their place and control insects by other means. Crop rotation avoids the build up of soil-borne diseases. Plant crops from the same family in a different place each year. Two such common families include the cabbage or cole group (broccoli, cauliflower, cabbage, brussels sprouts, rutabagas and turnips) and the solanaceous group (eggplant, Irish potato, pepper, tomato).

Resource conservation in gardening depends on the thoughtful and wise approach to the use of the nutrients, water and pesticides. It is our hope that the suggestions made serve as a guide for stewardship in your garden and serve as a stimulant for other ideas. ⁂

The lead problem in city soils . . .

HEAVY METALS AND THE URBAN GARDEN

Eileen McDonough

Urban gardening has become tremendously popular in Boston in recent years. Like thousands of people across the county, Bostonians have begun to brighten vacant lots and yards with gardens, cultivating not only healthful vegetables but also a new relationship with their city and their neighborhoods. The ethnic diversity of the city, with its variety of peoples from agrarian cultures, provides a wealth of skills for "greening" the urban environment.

However, as wonderful as the return to the land is, problems have become evident. One of the most difficult is environmental pollution. Pollutants affect wildlife, waterways, vegetation and humans through contaminants in the air, water and food supply. Inevitably, urban gardens are affected too, and one element which has been recently identified in urban soils and vegetable produce is *lead.*

As recently as 1977, it was believed that air-borne lead from automobile exhaust and factories was the chief contributing factor in lead contamination of urban garden vegetation (Rosen, W.G. and Preer, J.R., *Lead and Cadmium Content of Urban Garden Vegetables*, University of Massachusetts; Boston, 1977). This research concluded that particular types of urban-grown produce contained significant amounts of lead. Boston's urban gardening proponents naturally became concerned, and the Massachusetts Department of Food and Agriculture's Division of Agricultural Land Use called together an *ad hoc* task force of agencies, groups and concerned individuals to consider a more thorough investigation. The emphasis was on finding ways to reduce any possibility of lead contamination in garden produce.

This task force sponsored a citywide collection of soil and plant tissue samples from 65 community gardens. In addition, two members of this group—T. M. Spittler of the Regional Environmental Protection Agency in Lexington, and W. A. Feder of the University of Massachusetts Suburban Experiment Station in Waltham, began a joint research project (*A Study of Soil Contamination and Plant Uptake of Lead in Boston Urban Gardens,* Boston, 1978). Their findings indicated that:

1. Suffolk County (Boston-area) soils are lead contaminated.
2. There exists a high correlation between the lead level in the soil and some vegetables grown in that soil.
3. In a controlled-air environment there is a high correlation between tissue lead level in produce and the soil lead level, implying that the plants take up lead from the soil.
4. The source of soil lead is primarily the lead-based exterior paint used on the frame houses so common in New England. This lead enters the soil through acid-rain leaching, scraping and repainting the houses, and, on house-lot community gardens, the demolition of the houses themselves. Its life in the soil, once there, is up to seven hundred years.

Rapid Response

As a result of these findings, the Suffolk County Extension Service established a special soil testing project within its Greenstock Urban Gardening Program. The task was to determine both the possible hazard posed by lead in the soil to urban gardeners and to establish an outreach program of soil testing, education and information for gardeners before they planted their crops. A free service was developed which provides for tests of urban garden soils for lead and pH balance, and information is distributed on good gardening practices where lead is a concern.

Any gardener in Boston who feels lead may be a problem in the garden soil receives instructions on taking several garden soil samples, specifically for a lead test. The level of lead in the soil can vary in even a small area depending on a variety of factors such as proximity to buildings, composition of soil and history of the site. Therefore a map is included in the soil sample instructions so the gardener can record the sites in the garden where the samples were taken. This map is used as a reference when the test results are returned. The soil samples are logged and coded at the Extension Service office and then sent to the regional EPA laboratory where a lab technician hired by the Greenstock program tests the samples for lead on an X-ray fluorescence spectrophotometer and for pH balance. The gardener is then sent a packet in the mail containing the result of the pH test and lime application recommendations to bring the pH balance to 6.5 to 7.0, an overview on sources of lead in the total environment and the special care necessary with children under 6 years of age, the results of the test for lead, indicating whether the samples were low, medium, high or possibly dangeous, and the booklet, *Good Gardening Practices Where Lead is a Concern.*

USDA/William E. Carnahan

A soil test can confirm the presence and amount of heavy metal contamination.

In cases where high and possibly dangerous lead levels are found, the gardener receives a follow-up call to answer particular questions and to discover if children under age six are involved. Because of their small size and rapid development, children are much more susceptible than adults to lead poisoning from all sources. If children are in the household, the parents are encouraged to have the children's blood lead level tested.

Suggestions

Here are some suggestions from the booklet on *Good Gardening Practices Where Lead is a Concern:*

1. Gardeners are advised to keep soil pH balance between 6.5 and 7.0, as there are indications that less lead uptake occurs in a mildly acid soil medium.
2. In high or possibly dangerous lead level soils, gardeners are advised to grow leafy greens in containers of clean topsoil. The foliage of a plant appears to absorb and retain lead from the soil in direct correlation to the soil lead level.
3. Vegetables grown for their fruiting parts (eggplants, tomatoes, peppers, squash, etc.), legumes and grains are relatively unaffected by soil lead levels; thus gardeners are advised to give preference to these crops, and ornamentals, in high and possibly dangerous lead level soils.
4. Increased organic matter in the soil inhibits plant lead uptake; therefore, gardeners are advised to add organic matter through composting and cover cropping.
5. The farther samples are taken from a heavily traveled street, the lower the soil lead level is because the atmospheric lead is heavy and settles out quickly. Therefore, gardeners are advised to plant at least 50 feet back from a busy street or to erect a screen of plants or fencing around the garden.
6. The finer the dust particle, the higher the lead load; therefore, gardeners are advised to practice mulching techniques to keep dust off the plants.
7. There is some indication that environmental pollutants collect in the outer fiber of the root crops; therefore, gardeners are advised to peel all root crops.
8. With children it is recommended for high and possibly dangerous soil lead levels that the gardeners erect small tables and sand boxes to keep the children from playing in the soil, that they discourage hand-to-mouth activity in the garden and that they wash children's hands thoroughly before eating or when they come in from playing.

It must be noted that we approached this whole subject with extreme caution. Many people today are beginning to feel battered by the flood of information on carcinogens, pollutants and health hazards in our society. It is also important to realize that, in a city of concrete, tall buildings and blacktop, the growth of a garden is very fragile and easily destroyed. An increasing number of city people will grow food where they see vacant land. They will struggle against all odds, but they are easily discouraged when the government steps in. This is reflected in the despairing comment made by a Hispanic resident in Boston's South End. "I finally have something I'm proud of, my garden. Why are they attacking even this?"

And there are those who want instant solutions. A gardener called and asked if we could send her something to kill the lead. Unfortunately, there are no easy or instant solutions. Lead is relatively immobile once in the soil, and tends to remain in the top 6 inches for hundreds of years. If the topsoil is scraped off, where will it be dumped? Wherever it goes, it becomes someone else's problem. Also, clean topsoil is now prohibitively expensive and difficult to obtain because of new legislation prohibiting the trucking of topsoil across county lines.

In addition, the problem of contaminated soil is not just an urban problem. It exists anywhere that lead was deliberately or inadvertently applied. This would include areas around older painted structures (houses, bridges, towers, etc.), areas around factories using lead and any fields or orchards where lead was used in combination with other elements as an insecticide.

The service established in Boston for dealing with the potential health hazard of lead in urban gardens has maximized the healthful benefits of urban gardening and tried to keep the threat in proportion. The integration of resources from the great variety of environmental, agricultural, public health and community-based organizations represented on the Ad Hoc Lead Task Force has provided a public service enabling us to deal with the problems in our own backyards, while developing solutions and policies to rectify the situation. ✤

AN INVITATION TO JOIN AND ENJOY

A man does not plant a tree for himself;
he plants it for posterity.
—Alexander Smith

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GARDENING WITHOUT PESTS

Insects, Fungi and Viruses
on Trees, Shrubs and Flowers
Weed Control/Air Pollution
Comprehensive Treatment Guide

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GARDENING WITHOUT PESTS

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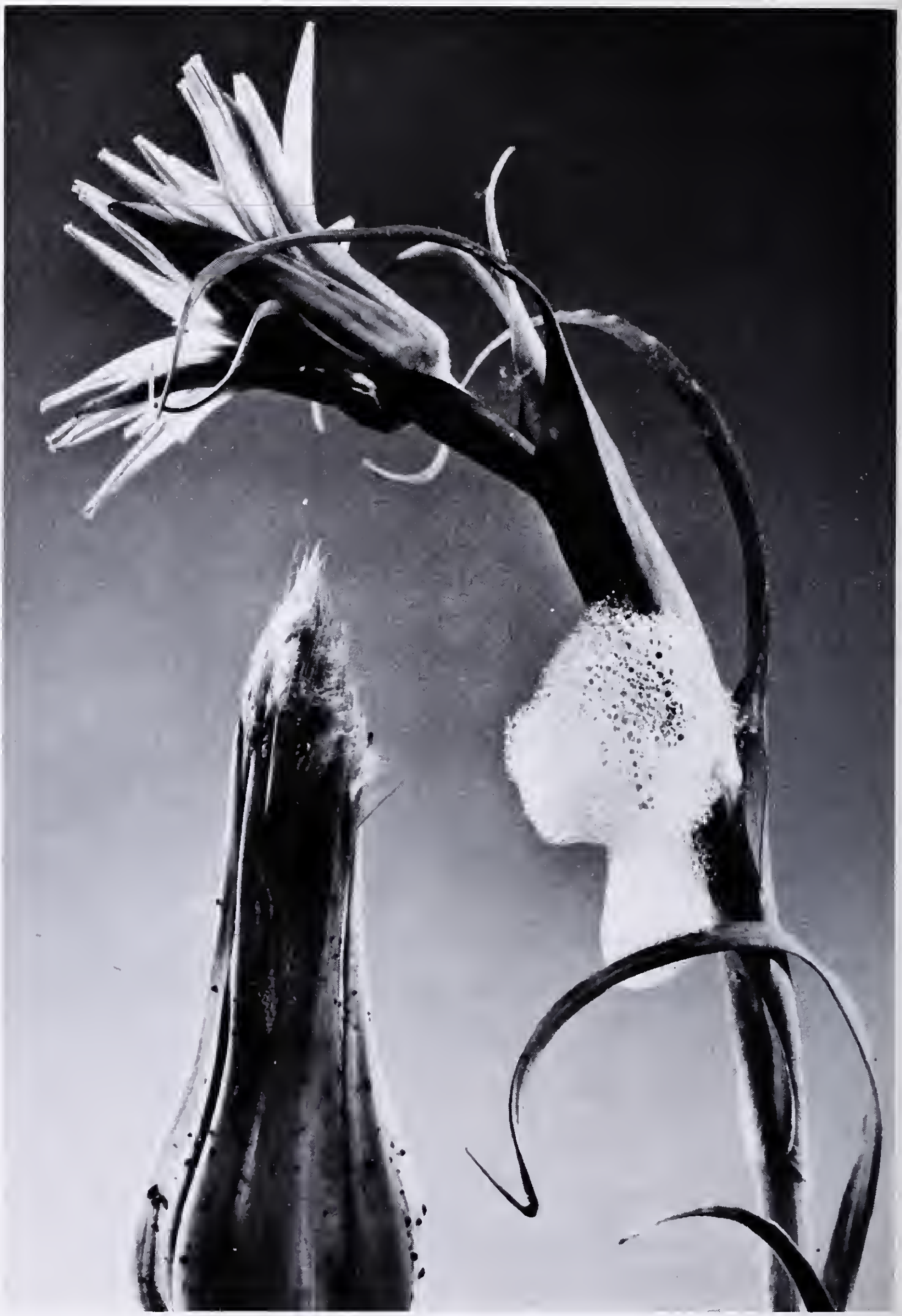


Roche

Spittlebug is common and relatively harmless. The froth is a covering for either eggs or nymphs (young). Lindane can be applied for control.

LETTER FROM THE BROOKLYN BOTANIC GARDEN

How sweet they are, the catalog photographs of tree-ripened fruits, perfect rose blossoms, emerald-green lawns. Regardless of age or experience, we all have dreams, but the reality of August in the garden frequently does not match the reveries of January. New gardeners are especially distraught to see the leaves of their choicest plants chewed by insects or grayed by mildew. It seems enough to make a person give up gardening!

But is it? Rather little that we value in life comes without some toil and disappointment, and this includes gardening. Every veteran gardener has put his share of dead plants, presumably disease-free, on the compost heap or in the garbage. (It is a good thing that compost heaps can't talk!) A *good* grower will try to find out what it is ailing his plants *before* an epidemic breaks out and then take the necessary measures to restore health. Frequent, careful inspection of the garden is important. This does not mean that every aphid on every crabapple can or should be sprayed, but staying on top of potential problems helps.

Where does one get the information? There are a wealth of insects and diseases, and not even the experienced grower is able to know all of them. One can't always bother the county extension agent. The little guides put out by the pesticide manufacturers and lawn-industry people often have excellent illustrations. Also some good texts have appeared, but they may be too comprehensive for the beginning gardener. The aim of this Handbook is to introduce you to the main garden insects and diseases you may encounter, and to give background information about them that can be of help in controlling them. In this connection the Botanic Garden has been fortunate to enroll a knowledgeable veteran of the scene as Guest Editor, Spencer Davis. Many thanks to Dr. Davis and his team of fellow authorities who have made this Handbook possible.

It is said elsewhere in this Handbook, but it bears repeating; healthy plants have a way of staying healthy. How important it is to grow plants in their proper environment and not under constant stress—the woodland tree forced to serve as a pet green stick on a lawn, the sun lover consigned to a forlorn spot in the shade. Plants may encounter problems even when conditions seem to be perfect, but the problems usually will be fewer. The study of insects and plant diseases themselves is a fascinating pastime, and no garden will disappoint in subject matter. In fact, the great majority of insects are either harmless or beneficial, and one can open a whole new world by learning about the common kinds. Don't be discouraged. Let this Handbook help you.

Sincerely,

Frederick McGourty, Jr.

Editor

P.S. For a companion volume consult the BBG Handbook, *Biological Control of Plant Pests*. See back cover for ordering information.

Always some need for . . .

PEST CONTROL IN YOUR GARDEN

Spencer H. Davis, Jr.

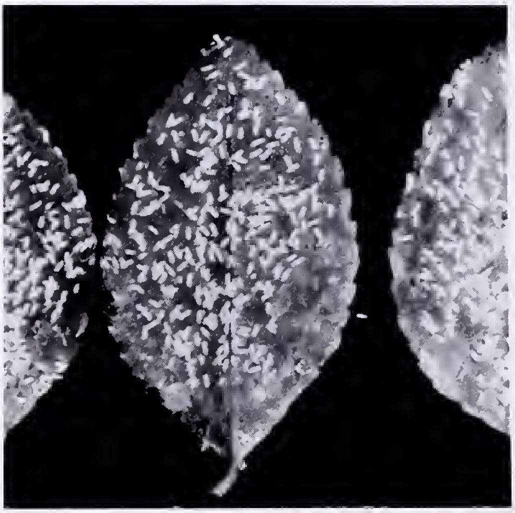
The ideal situation for your garden would be one of beautiful flowers, foliage and fruit and no diseases or insects. Then you would have no need for pesticides—fungicides, insecticides and miticides. The first part may be true in your garden, but we doubt that you have no pest problems unless you are now using some pesticides. But the less pesticides the better.

Assuming you do occasionally run into some disease or insect problems on your flowers, shrubs and trees, there are several methods to correct the situation. You may pull out and discard the infected or infested plants and never plant that kind again; you may remove and then replant with resistant or less susceptible varieties of the same kind of plant; or you may select the correct pesticide to prevent or eradicate the pest. The chart which follows will help in the selection and use of the proper pesticides and the correct time to apply them.

If you want to reduce the amount of pesticides you use and the time spent applying them, then do some planning before planting your garden. When you are ready to set out your garden, read the description of the plants carefully and completely. Do not make your selection just from the varieties with the prettiest and most colorful flowers. Look in the description of the varieties for the word "resistant." Look for *wilt* resistant, *mildew* resistant, *virus* resistant, etc., when you make your selections and you will have a lot less need for pesticides.

Much has been done in developing resistant varieties and much more is being done (see the article by Frank Santamour on page 20), yet we still have a long way to go. In the meantime, if you have plant pest problems you may have to use pesticides.

Pesticides like everything else in this world (except things like diseases, insects and weeds) will come and go. When new pesticides with better plant protection appear on the market, the older ones gradually pass on or are ruled out by the Environmental Protection Agency (EPA). In preparing this pest control chart we



L. M. Vasvary

Euonymus scale on leaves.

Herman Gantner

The presence of natural pest control in the form of toads, birds and snakes can cut down on the amounts of insecticides needed in the garden.

have tried to select the best materials available and those which are labeled or accepted for use in the home garden.

The names used for the pesticides are called "generic" or common names assigned to a group of similar or identical chemicals. For example, when you read maneb as the generic name, this applies to brand names such as: Polyram M, Manzeb, Maneb 80, Manzate, Manzate D, Tersan LSR, Dithane M-22 and Dithan M-22 Special. We do not list brand names unless there is only one manufacturer and no generic name has been assigned to that chemical.

Keep in touch with your State Agricultural Station or County Agricultural Agent for current pesticide recommendations in your immediate locality.

If you do not want to worry about the specific chemical best for control of each pest, then use a "general purpose" fungicide-insecticide combination. These G.P. combinations will contain two or more fungicides and insecticides to give you good control of the majority of plant pests.

As a rule, it is well to add a "spreader-sticker" to any spray material you will use on glossy-leaved plants such as tulip, gladiolus, onion, rhododendron, laurel, pine and spruce. This spreading-sticking agent gives a better coverage and distribution of the pesticide over the waxy or glossy surface.

If you use dusts instead of sprays, try to make applications when plants are moist from dew or right after a rain for better dust retention by the plant. When the water evaporates, it will leave the pesticide tightly fastened to the leaf surface.

While we have not listed every fungus and insect problem of garden plants, we

Pesticide Formulations and Amounts to Use

Pesticide	*Trade name(s)*[a]	*Formulation*[b]	*Amt per 1 gallon*[c]
acephate	Orthene	15.6% LC	1½ Tb.
Bacillus thuringiensis	Dipel, Thuricide		MR
Benomyl	Benlate	50 % WP	½ Tb.
captan	Captan	50 % WP	2 Tb.
carbaryl	Sevin	50 % WP	2 Tb.
copper	COCS, Kocide		MR
Daconil	Daconil	75 % WP 4.1% F	2 Tb. 2 ts.
diazinon	Diazinon, Spectracide	50 % WP 25 % LC	1 Tb. 1½ ts.
dicofol	Kelthane	35 % WP 18.5% LC	1½ Tb. 2 ts.
dimethoate	Cygon, De-Fend	23.4% EC	2 ts.
dodine	Cyprex	65 % WP	½ Tb.
dormant oil	....		MR
dylox	Dylox	50 % WP	1½ Tb.
ethion	Ethion	25 % WP	MR
ferbam	Fermate	76 % WP	2 Tb.
folpet	Phaltan	75 % WP	1½ Tb.
Karathane	Karathane	22.5% LC	½ ts.
lindane	Lindane	20 % EC	3 Tb.
malathion	Malathion	25 % WP 57 % LC	2 Tb. 1 ts.
mancozeb	Manzate 200, Fore	80 % WP	1½ Tb.
maneb	Dithane M-22, Manzate	80 % WP	1½ Tb.
Metasystox-R	Metasystox-R	25 % EC 50 % WP	1½ ts. 3 Tbs.
methoxychlor	Marlate	25 % EC	2 Tb.
rotenone	Rotenone		MR
tetradifon	Tedion	25 % WP	1 Tb.
Vapam	Vapam		MR
zineb	Dithane Z-78, Parzate	75 % WP	1½ Tb.

[a] Examples only: other trade names available
[b] Formulation: WP=wettable powder, LC=liquid concentrate, EC=emulsion concentrate, F=flowable
[c] The usual dilution: check label for manufacturer's recommendation (MR)

do list those which are most common or troublesome. In your locality, there may be local problems which are known and recognized by your County Agricultural Agent. He is a good person to know. Get on his mailing list for suggestions for the home gardener.

Good luck with your pest control program as you follow the recommendations in this pest control chart. ❧

Tested ways to get rid of unwanted plants . . .

WEED CONTROL AROUND THE HOME GROUNDS

John A. Meade

First of all, let's define the word "weed." It is a plant growing where it is not wanted. This makes a corn plant growing in an azalea planting a weed. On a more philosophical note, some people say it's "a plant whose virtues have not yet been discovered."

Why are these plants not wanted? Because they compete for fertilizer, water and space, eventually crowding out desirable plants or reducing their vigor; destroy the appearance of lawns and ornamental plantings; serve as alternate hosts for insects and disease organisms.

Methods of Weed Control

Biological—there are a few successful examples of an insect or fungus attacking and destroying a weed without attacking desirable plants. In a New Jersey experiment, insects known to have destroyed nodding thistle and Canada thistle elsewhere have been introduced in the hopes of doing the job here.

Mechanical—you have been doing this, in the form of pulling weeds, for years and will probably have to continue for some time. Don't overlook the monofilament spinners, which are relatively new, lightweight mechanical weeders that work on gas or electricity. They do a great job around concrete walls, trees and poles. Don't let the whips hit trees. They will skin bark.

Mulch—there are many kinds. Most widely used are the organics—wood chips, licorice root, etc. Remember that you need four inches or more to effectively stop seedlings and that the area should be weeded first. A mulch is no help with perennial weeds if roots are established. Black plastic is also useful for stopping seedlings; cover with an organic mulch or stones for aesthetics. Keep mulch a couple of inches away from the stems of plants.

Herbicides—this method of weed control has gained popularity because of economics and effectiveness. There are many situations where herbicides can be used around homes.

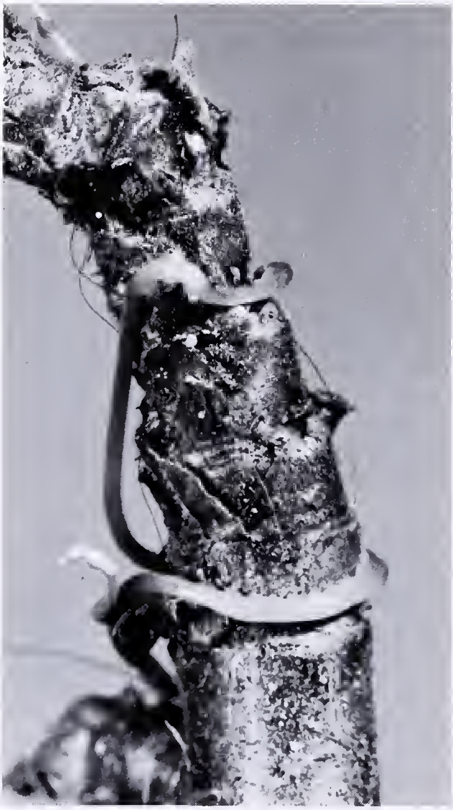
Herbicides

General Cleanup. For weeds such as poison-ivy, Japanese honeysuckle, thistles, milkweed and cattail, the herbicide amitrole, sold as Weedazol and Cytrol, is excellent. Poison-ivy should be sprayed in full leaf, the other weeds in the bud stage or mid-summer.

Amitrole should not be used on weeds growing among desirable plants since it will kill the desirable ones if it gets on the leaves. It may be used as a directed spray beneath trees and adjacent to hedges if kept off desirable plants. Weeds in hedges or flower beds can be treated by painting the chemical onto the weed leaves or by application with a sponge. Most visible weed leaves must be treated. Turfgrasses are also susceptible to amitrole. Amitrole is not toxic, caustic or corrosive, and may be washed out of the sprayer with detergent and water.

Ammate (ammonium sulfamate) is sold for brush control. As with all herbicides, use according to directions. It is somewhat corrosive to metal so should be washed out of the sprayer right after use.

Unlike Ammate, 2,4-D is translocated into the root systems and gives more permanent kill. It must be used carefully since small quantities (as in the mist from the spray) can fall on desirable species and cause injury. Use a sprayer with large droplets and low pressure. The material 2,4-D cannot be effectively removed from the sprayer, which



Rutgers University

A closeup view showing how dodder penetrates the host plant. Once attached it is very difficult to remove and often the host must be destroyed.

should be marked "For Weeds Only."

Woody Species—Dormant or Basal Treatment. Until recently a common procedure was to treat small brush, stumps or regrowth sprouts with a 2,4-D + silvex mixture, sold usually as brush killer, in #2 diesel oil or kerosene. (As a summer foliage spray, water was substituted for oil or kerosene.) Silvex has been provisionally removed from the market by the Environmental Protection Agency, so readers are urged to check with their county agent concerning the most recent chemical to use.

Trouble Spots

Flowers and Gardens. Most home gardeners enjoy working the soil and pulling weeds, but a little help from herbicides might be appreciated. For general use, the common preemergence crabgrass preventer, Dacthal, can be used among many kinds of flowers, shrubs and vegetables. Eptam is another product marketed for use among flowers and shrubs. Treflan and Dymid are two others sold in small packages. A check of the label of the various preparations will reveal the plants and vegetables on which they can be used.

Lawn Weed Control is designed to prevent germination of annual grasses and control of broadleaf weeds. A tight, dense turf, properly managed, is the best way to prevent weed invasion. If annual grasses such as crabgrass are a problem, try a preemergence application of a crabgrass preventer in spring. These chemicals are applied about the time forsythia blooms. Raising the height of mowing to 1½″ or 2″ will control crabgrass, too.

Broadleaf weeds are best controlled when you can see them. They can then be spot-treated as needed. Garden centers stock several herbicides for different broadleaf weeds, so check labels before purchase. A midspring application is usually best. A fall treatment provides control of dandelions for next year. Since these herbicides may injure desirable plants, it is important to read the label carefully, noting all directions and precautions.

Ditches and Grassy Waste Areas. Home grounds are often contaminated by weeds spreading from waste areas along ditches and streams. The utility value of these ditches is often reduced by heavy growth of vegetation. Grasses may be kept down for a year, and often killed, by using one pound of dalapon (sold as Dowpon at farm supply stores) in ten gallons of water and wetting the growing grass to runoff. The same treatment will control common reed (*Phragmites*). Apply dalapon when this perennial grass is twenty-four inches tall, wetting all leaves thoroughly but not excessively. A second treatment may be necessary in four weeks.

Total Vegetation Control. In some

areas, *e.g.*, driveways, fence rows and industrial sites, the absence of all plants is desired. Several long-lasting and dependable chemicals are available. Trade names include Pramitrol, Triox, Ureabor, Chlorea, Hyvar and Urox. Most are available in pelleted form. They may be spread by hand on a measured area, according to label directions. *Caution*: These soil sterilants should not be used near desirable trees or shrubs. Be very careful of the surrounding areas when using them. Once in the soil, their action is difficult to stop, but, if necessary, activated charcoal may be used to alleviate some of the effects of these herbicides.

Borax and mixtures of 2,4-D + dalapon may be used where trees or other desirable vegetation are in possible danger from the soil sterilants. These materials are usually applied in liquid solution in water. Label directions for the various products should be followed for a season's control of unwanted vegetation.

Contact herbicides should be used where desirable vegetation is present or where slopes may cause the soil sterilant to move into lawn areas. These chemicals kill those plants they come into contact with but they do not remain active in the soil. This means that new weed seeds will germinate, but a treatment two or three times a year will usually keep growth down. Most of these preparations contain cacodylic acid or salts of dimethyl arsenic acid. These organic forms of arsenic are much safer than the older forms such as sodium arsenite.

Brick Patios and Sidewalks. No permanent soil sterilants should be used for weed control here because they wash off the bricks or stones and kill the grass in the vicinity. The contact herbicides Phytar, Broadside or Rad-i-cate containing cacodylic acid or its salts are a better choice for these areas. They should be applied sparingly and directed carefully to the weeds. An application of one of the preemergence crabgrass preventers will keep crabgrass out.

Special Weeds

Aquatic Weeds. Diquat, Endothal, 2,4-D and copper sulfate are some of the chemicals that may be used for these aquatic pests. Effective treatments are known but will not be given in detail here because of the complications arising from the presence of fish and the use of water.

Japanese knotweed, also known as *Mexican-bamboo*, was originally sold as an ornamental under the name of fleece flower and has escaped from cultivation to become one of our most pestiferous weeds. (Botanical name: *Polygonum cuspidatum*.) It has also been favored by highway departments as a bank cover. Although having a shrubby appearance, it is a herbaceous perennial, forming long tough rhizomes (underground stems) from which new plants sprout and attain heights of six-to-eight feet in a few weeks. If unchecked, clumps become exceedingly thick and present a menace along highways where they obstruct vision on curves and at intersections. Continuous clipping will vex the plants somewhat and prevent them from building root reserves for next year, but a persistent effort is required to keep them from regrowing.

Dodder (Cuscuta spp.) is a plant without a food production process so it attaches itself to green plants and derives its nourishment from them. This leafless parasite is easy to recognize since it is our only yellow or orange vine, wrapping tightly around plants. An annual, it starts from seeds each spring. The young yellow-orange tendril waves around until it strikes a plant and then twines around that plant and attaches its suction "hoses," known as haustoria. It then breaks off at the ground level and lives off the host plant. Once dodder has attached itself to the host plant, one must remove the host, also. This plant then should be placed in a plastic bag and disposed of to prevent seed dissemination.

Dodder can be controlled by preventing seed germination in spring. The most practical way is by means of Dacthal. Fortunately, this product is safe for humans and pets and does not remain long in the soil. It is safe to use on almost all ornamentals. It also controls purslane and most annual grasses.

Dodder germinates in early spring so Dacthal must be applied in mid-April. Use it at the same rate suggested for

L. M. Vasvary

Lawn weeds such as this black medic (*Medicago lupulina*) can be controlled by proper management or by the use of herbicides.

lawns. For full season control it would probably be best to retreat the area in late July. If you don't care to use herbicides and dodder was present in past years, it would be best to keep a sharp eye on the areas and as soon as the yellow tendrils show up, rake the bed and destroy them. Germination can take place over a period of several weeks so keep watch.

Cultural Means of Control

It has already been mentioned that the vigorous growth of turf and the proper height of mowing are good weed control measures. There are many practices that good gardeners have been following for years that compete with weeds without the use of chemicals. Using a rake, hoe, mulch and clean soil for potting and for beds, and the proper liming and fertilization are some of the main cultural means of controlling weeds. Ornamentals and over-wintering plants may be mulched heavily enough to prevent the growth of weeds through the mulch. This mulch can then be raked off at a time most suitable for the growth of the plants. Black plastic laid in strips along rows in the vegetable garden can reduce weeding. In addition, it can be used to cover an entire garden area, with holes cut in it for plants.

A timely raking or hoeing of the flower garden may be a very effective control measure. As a rule, weed seeds germinate within one-half inch of the surface, and they germinate fairly quickly when the ground warms up in the spring. When they come up in quantity, they may be dislodged easily without disturbing the soil or the plants to any extent. Several rakings at the right time in May and June may eliminate the weed problem in July and August. However, once the weeds have been permitted to establish themselves, they must be pulled by hand and care must be exercised so other plants are not damaged.

Seeds of annuals or vegetables should be planted at a time most suitable for their growth and least suitable for the weeds, if that is possible. Flowers that are planted from seed may have reduced competition if the seedbed is prepared several weeks before planting. Weed seeds will then germinate within a week after the seedbed is prepared, and a light raking at that time will remove the first crop before you sow your own. These cultural measures of control are all things that gardeners do by instinct and by knowledge of good husbandry of the soil and the crop. Nevertheless, it is wise to reemphasize the various means of control that are available to us before we turn to chemicals. Chemicals in weed control should not be a crutch for poor gardening practices but rather an aid to good ones.

For a more complete discussion on this subject, see *Weed Control in the Home Garden*, BBG Handbook #73.

Helpful keys to . . .

RECOGNIZING AIR-POLLUTION DAMAGE

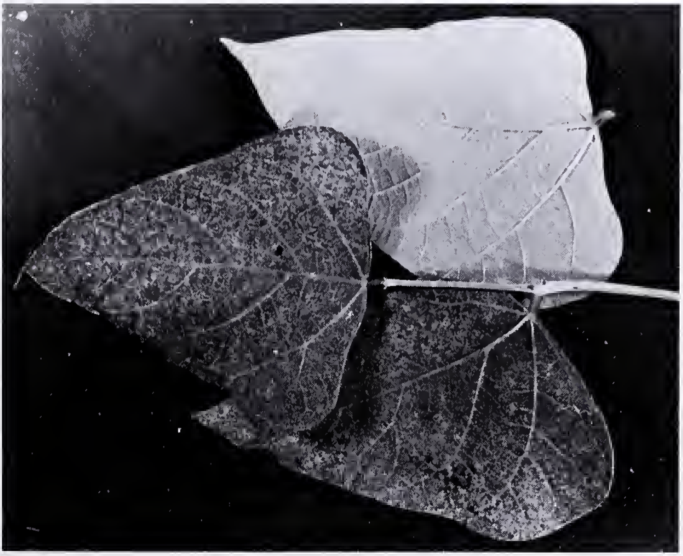
Ann F. Rhoads and Eileen Brennan

People are aware of periods of severe air pollution when visibility is poor, eyes burn, and nasal passages and throats are irritated. Plants also are affected by toxic substances in the atmosphere. In most cases specific, recognizable evidence of damage is produced on plants at pollution levels lower than those required to produce symptoms in humans; therefore plants can serve as a warning that pollution levels are approaching dangerous concentrations. Only in recent years have we become fully aware of the plant-damaging potential of many pollutants. Major pollutants often implicated are ozone, sulfur dioxide and hydrogen fluoride.

Conditions Favoring Damage

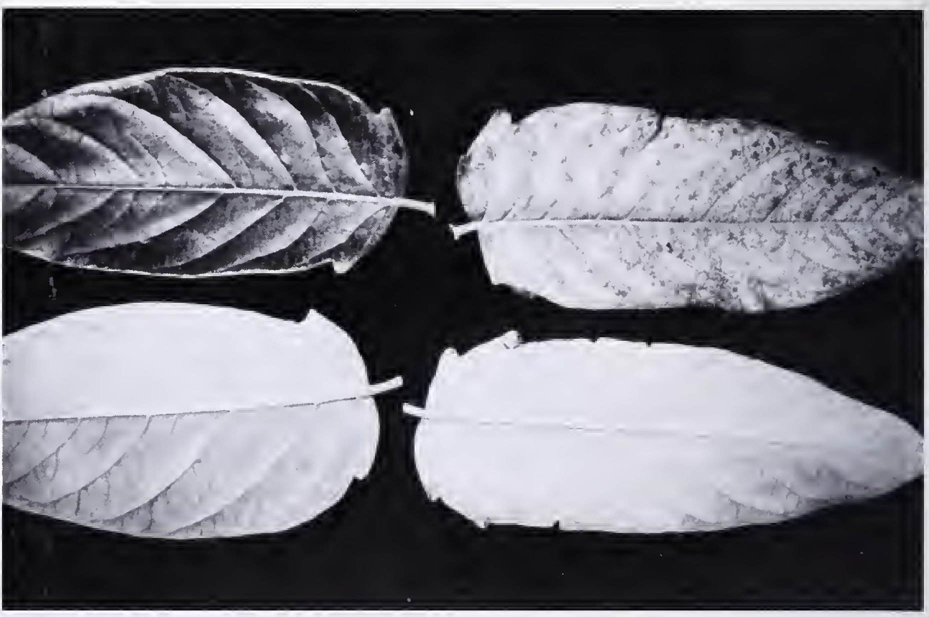
Go into a garden in the Northeast anytime during the growing season, and you can see effects of air pollution on sensitive kinds of plants. For air-pollution damage to occur two factors are necessary. First, a pollutant or pollutants must be present in the atmosphere in high enough concentrations and for long enough periods to be harmful; second, sensitive plants in a susceptible condition must be present. Most air-pollution damage occurs when periods of air stagnation permit the accumulation of pollutants near the ground or when a local source emits excessive amounts of a toxic substance.

The sensitivity of plants varies with the species and even the cultivar. A study at Rutgers University indicated that among green beans the cultivar 'Tempo' is extremely sensitive to ozone damage while 'Long Tendergreen' is relatively resistant. In addition, the susceptibility of an individual plant is affected by age, fertility, water supply, root aeration and exposure to light. In general, healthy, well-



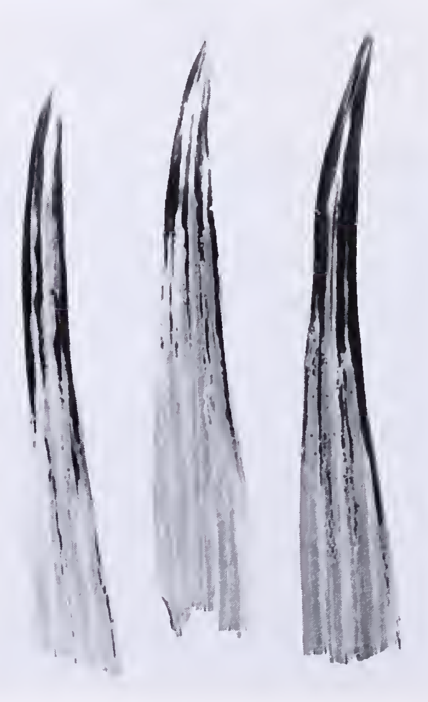
A. F. Rhoads

Ozone stipple on green bean; note the lack of symptoms on the lower leaf surface.



S. H. Davis

Above, ailanthus leaflets, upper and lower surfaces; left-normal, right-ozone damage. Below, marginal and tip necrosis of gladiolus caused by hydrogen fluoride.



A. F. Rhoads

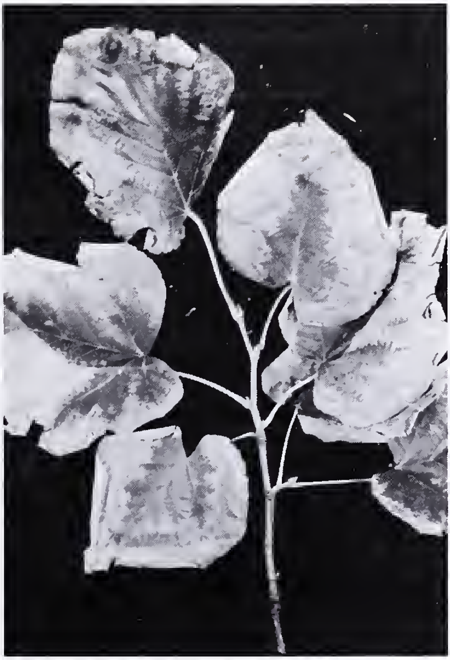
fertilized and well-watered plants in the vegetative stage of growth are the most susceptible.

Diagnostic Techniques

Air pollution doesn't leave behind telltale signs on which a positive diagnosis can be based. There are no spores or mycelium, no insect bodies or debris. In fact, the damage usually doesn't appear until twenty-four hours after exposure. However, research involving controlled fumigation of many plant species with known levels of individual pollutants has disclosed much about specific responses to pollutants, both in terms of symptom type and differential sensitivity.

It is by observing both the nature of the symptoms on individual plants and the extent of injury on a range of plants under the same kind of conditions that a diagnosis of air pollution damage can be made. In the case of pollutants such as sulfur dioxide and hydrogen fluoride, chemical analysis of plant tissues can be used for supporting evidence.

A useful concept is that of indicator plants. Indicator plants are widely distributed plants, sometimes weeds, with a specific sensitivity to a single pollutant. In an area where pollution damage is sus-



A. F. Rhoads

Marginal browning and curling on littleleaf linden (*Tilia cordata*) caused by high soil salt levels in curbside planting pits. Air pollutants containing fluoride cause similar symptoms.

pected, indicator plants can be checked for symptom development to verify the diagnosis.

Ozone

The most widespread pollution problem in the Northeast is caused by ozone (O_3), a component of photochemical smog. A number of widely grown vegetable crops are routinely injured by ozone several times during the growing season. Ozone injury usually develops following periods of air stagnation during which sunlight and accumulated automotive exhaust products create conditions for the production of significant levels of the pollutant.

Ozone injury to leaves occurs as pale bleached-looking flecks or spots on spinach, cucumber, zucchini, parsley and nasturtium. On other plants ozone damage to leaf tissue results in dark-pigmented stippling. This type of symptom is very common on green bean, lima bean, white potato and grape. Trees are generally less sensitive than non-woody plants, but Japanese zelkova, eastern white pine and several species of linden are often affected, and individual trees may be almost completely defoliated.

Ozone symptoms, either fleck or stipple, are most noticeable on the upper surface of the leaf, a characteristic which aids in diagnosis. Severe symptoms eventually cause leaves to turn yellow and drop. Because only the recently expanded leaves are in a susceptible condition at a given time, repeated waves of damage can occur through the growing season as new leaves reach the susceptible stage.

Point Source Pollutants

Sulfur dioxide (SO_2) and hydrogen fluoride (HF) are gases with phytotoxic (plant-damaging) potential. Unlike ozone, they are usually emitted from specific point sources and have a localized effect. Highest concentrations are found nearest the source and a gradient of plant damage can usually be observed radiating out in a downwind direction.

The most common source of sulfur dioxide in the atmosphere is the combustion of fossil fuels, especially those high in sulfur content. Sulfur dioxide injury on vegetation appears as tan areas of necrotic (dead) tissue located between the larger veins of the leaf. Unlike those caused by ozone, the lesions resulting from sulfur dioxide penetrate the leaf from top to underside. Some plants commonly injured by sulfur dioxide include begonia, tomato, apple, clover, birch and rose. Violet and zinnia are useful indicator plants.

Hydrogen fluoride is another common pollutant originating from industries involved in the production of aluminum, steel, ceramics and phosphate fertilizers. Hydrogen fluoride causes characteristic browning of the edges (margins) of the leaves of sensitive plants. These include tulip, grape, peach, cherry, sweet corn

Summary of Common Types of Air-Pollution Damage and Mimicking Symptoms

Pollutant	Sensitive Plants	Symptom Type	Mimicking Symptoms
Ozone	Green bean, lima bean, potato, grape, linden, zelkova	Purple-black stipple upper leaf surface	Normal aging
Ozone	Spinach, zucchini, radish, cucumber, tobacco	White or pale yellow flecking upper leaf surface	Mites and sucking insects (lacebug, leafhopper, etc.). Check lower leaf surface
Ozone	White pine	Chlorotic mottling or flecking of needles, browning of needle tip	Aphids or mites
Sulfur dioxide	Apple, zinnia, violet, birch, rose, blackberry, oak, tomato	Tan or brown irregular dead areas between main leaf veins	Salt, winter wind burn, herbicide
Hydrogen fluoride	Gladiolus, grape, sweet corn, apricot, plum	Browning of leaf edges	Salt, excessive fertilizer, drought, pesticide toxicity
Hydrogen fluoride	White pine, Austrian pine, larch, Blue spruce, Douglas fir	Browning of needle tip	Sulfur dioxide, severe ozone, salt, winter wind burn, herbicide
Hydrogen fluoride	Peach fruit	Premature ripening of suture area	Several pathogens and growth regulator chemicals

and blueberry. A number of conifers also show sensitivity to HF, developing needle-tip necrosis, which in severe cases may extend over half or more of the needle length. Gladiolus is a useful indicator plant.

Mimicking Symptoms

A difficulty in diagnosis arises because several other conditions may mimic air-pollution symptoms. For instance, feeding by several types of mites and sucking insects, such as white flies, lacebugs and leaf hoppers, causes white flecking on leaves much like ozone damage. Careful examination of the lower leaf surface, however, will usually reveal evidence of insects when they are involved.

Necrotic lesions similar to those caused by sulfur dioxide may be the result of fungal diseases such as anthracnose. A microscopic examination may be necessary to determine whether a fungal pathogen is present. Insects such as the birch-leaf miner can also mimic sulfur dioxide lesions, but careful scrutiny should reveal larvae and frass (insect debris) in the necrotic area.

Drought, excessive fertilizer or accumulated de-icing salts may create symptoms mimicking damage by hydrogen fluoride on broad-leaved plants. Salt may also cause tip burn on conifers.

A wide range of pollutants acting singly or in combination have been shown to possess plant-damaging potential. In all cases it is necessary to examine individual plants carefully and to check many plant species, especially indicator plants, before making a diagnosis. ❧

A common garden problem . . .

CHLOROSIS—
WHAT IS IT AND
WHAT CAN WE DO ABOUT IT?

Elton M. Smith

The dictionary definition of chlorosis is: An abnormal condition of plants, characterized by absence of or deficiency in green pigment and caused by lack of light, mineral deficiency or genetic disorders. From a horticultural standpoint, several other causes could be added to the list, including: inadequate soil drainage, soil compaction and resultant poor soil aeration, mechanical root injury or pruning, soil insects and diseases, temperature extremes, girdling roots and mineral toxicities, among others. To correct the chlorosis problem, considerable investigation may sometimes be necessary since the condition is usually soil-related and not as obvious as foliar disorders. In many instances, however, chlorosis is directly related to mineral element deficiencies.

Symptoms

Nitrogen deficiency appears as a uniform loss of green color over the entire leaf, varying from a pale yellow-green to ivory color. This deficiency appears first on older foliage, and leaves are typically thinner than normal and reduced in size or number. Nitrogen deficiency is the most widespread kind and occurs on a wide number of woody plants.

Phosphorus deficiency results in small, dark green leaves often with a bronze to purple tinge. It is not as common in trees and shrubs as in herbaceous plants.

Potassium deficiency is often manifested as interveinal chlorosis, which is yellowing of foliar tissue between the midrib and veins. Potassium deficiency develops first on leaves at the base of shoots and advances toward the shoot tip as the season progresses. Chlorotic areas are followed by necrosis (browning) with some leaf rolling and early leaf drop. This deficiency is common in flowering dogwood, red maple and many plants grown in sandy soils.

Magnesium deficiency, more of a problem in acidic soils, develops as interveinal chlorosis on leaves maturing from early summer to fall. Chlorosis begins on oldest leaves, advancing toward the tip of the shoot as the season progresses. This condition can be used to differentiate magnesium deficiency from manganese or iron deficiency. Some species, including yew, podocarpus and citrus, show a chlorosis of only the foliage without necrosis. Necrosis may develop as marginal scorch and interveinal necrosis on spirea and yew. Severe magnesium deficiency greatly increases susceptibility of citrus in the South and yew in northern states to cold damage in winter. Other plants may be more susceptible to winter injury for the same reason.

Calcium deficiency of woody plants is not common but can be expected to result first in root injury, followed by chlorosis of young leaves, tip dieback and death of terminal buds.

Sulphur deficiency results in symptoms similar to nitrogen deficiency, as leaves become yellow-green, but it is usually found on young foliage rather than older growth.

Manganese deficiency is usually exhibited as interveinal chlorosis on new leaves of summer growth. Some plants such as red maple develop necrosis and a reduction in leaf size. Among other plants commonly manganese-deficient are Norway, sugar and silver maples, dogwood, flowering cherry, crape-myrtle and several palm species, particularly if grown in alkaline soils.

Iron deficiency symptoms first appear on young leaves at shoot terminals as a pronounced interveinal chlorosis with distinctive green veins. Chlorosis of foliage is followed by necrotic spots, or marginal scorch with leaf drop, branch dieback or eventual death of the plant, as is common with pin oak. Iron deficiency is often found in plants growing in neutral to alkaline soils—azalea, camellia, gardenia, magnolia, many oak species, rhododendron, sweet gum, white pine and others, especially ericaceous plants.

Zinc deficiency is characterized by interveinal chlorosis of terminal leaves of the current season's growth. As the deficiency becomes more severe, leaf size is markedly reduced, leaves become narrow and pointed, giving rise to the term "little-leaf." It is most prevalent in pecan, black walnut and fruit trees.

Copper deficient plants will exhibit varying symptoms, including interveinal chlorosis in jasmine, reduction of the size of youngest leaves with some cupping in wax-leaf privet, possible leaf wrinkling of camellia, and tip or marginal browning with irregular broken margins on some azalea species.

Boron deficiency is manifested as chlorosis on leaf tips, margins or between the veins. Leaves may then become small, leathery and variously malformed. Boron deficiency is not nearly as prevalent in woody ornamentals as it is in citrus and coconut palm in Florida.

Molybdenum deficiency has been reported on Chinese hibiscus and citrus as being similar to 2,4-D injury. Leaves are reduced in size, misshapen, and straplike. A mild chlorosis is evident on young developing leaves.

Proper Identification Necessary

To correct chlorosis, identification of the mineral element(s) deficiency or toxicity causing the condition must be made. The most common approach is to look for such differences as overall yellow foliage vs. interveinal chlorosis or chlorosis of old growth vs. new growth. A visual evaluation plus soil and foliar analysis will usually reveal a mineral element disorder.

Soil Analysis—soil tests should be used to diagnose suspected mineral element disorders and as a maintenance check during the life of the plant. A soil test will typically reveal soil pH, phosphorus, potassium, calcium and magnesium levels. Some labs test for cation exchange capacity, nitrates, sulfur, manganese, boron, iron, zinc and other minor elements. Soil-testing services are performed by most land grant universities, with forms and mailing kits available from county extension service offices. Many private laboratories also offer soil-testing services.

A soil test measures either the available or exchangeable mineral elements in the soil and not those in the plant. For this reason, foliar analysis may be necessary to diagnose some chlorosis problems.

Foliar Analysis—foliar or leaf analysis is a procedure in which leaf tissue is analyzed to determine the mineral element content within a plant. This technique is more precise than soil analysis because it measures levels already in plants and can be used to detect approaching deficiencies and high concentrations before visual symptoms appear, thus preventing growth reductions.

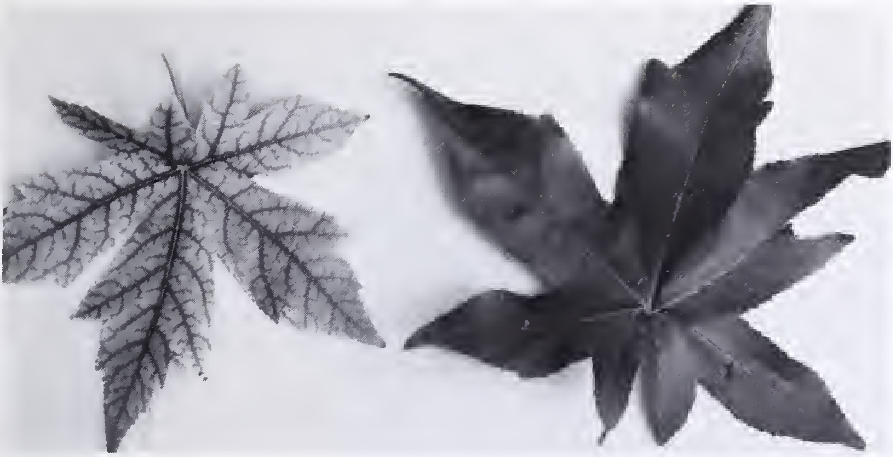
In the North, foliar samples should be taken between mid-June and mid-September, or later with evergreens, from plants that represent normal and abnormal conditions within the planting. Foliage should be removed from the midsection of the recently matured current season's growth. Approximately thirty to one hundred leaves, depending on size, should be selected from woody plants. About fifty terminal cuttings, two inches in length, should be removed from needle evergreens. Comparison of healthy plant tissue with chlorotic plants is often helpful in diagnosing plant nutrient problems. Foliar analysis will not reveal soil pH or cation exchange capacity, so should be used in conjunction with soil analysis in diagnosing chlorosis problems.

More detailed information and mailing kits are available at county extension service offices in many states. Some private laboratories also offer this service.

Correcting Chlorosis Problems

Fertilizers may be divided into two major

Photos: L. M. Vasvary



Left—chlorotic sweet gum. Right—a leaf from the same tree but the branch had been implanted with ferric ammonium citrate capsules.

groups, organic and inorganic. Organic ones are usually derived from a plant or animal source. Nitrogen in an organic fertilizer is slow to become available for plant use because the organic nitrogen must be reduced by microorganisms to ammonium or nitrate. Organic materials such as manure, processed sewage, tankage and cottonseed meal, although safe, are generally not used to correct chlorosis.

Inorganic or chemical fertilizers are manufactured or mixed and have the advantage of low cost, high analysis, rapid solubility and availability. They are most often the ones selected for control of chlorosis problems. Chemical fertilizers are marketed in many forms, including

Left—chlorotic red maple leaf. Right—red maple leaf from tree treated with trunk implants of manganese sulfate.

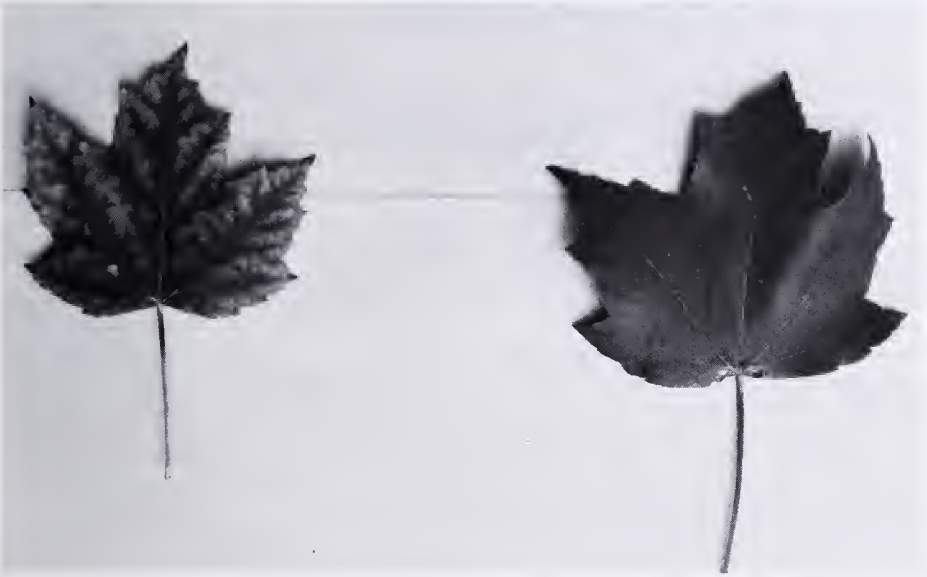


Table 1. Some Soluble Fertilizers

Mineral Elements	Name Of Fertilizer
Nitrogen	Ammonium Nitrate (33-0-0) Ammonium Sulfate (20-0-0) Calcium Nitrate (15-0-0) Sodium Nitrate (15-0-0) Urea (45-0-0)
Phosphorus	Mono-ammonium Phosphate (11-48-0) Di-ammonium Phosphate (21-53-0)
Potassium	Muriate of Potash (0-0-60) Sulfate of Potash (0-0-50) Potassium Nitrate (13-0-44)
N-P-K	Complete soluble fertilizers (20-20-20, etc.)
Calcium	Calcium Nitrate (15-0-0)
Magnesium	Magnesium Sulfate
Sulfur	Available in all sulfate fertilizers
Iron	Chelated Iron Iron Sulfate
Manganese	Manganese Oxide Manganese Sulfate Chelated Manganese
Zinc	Zinc Sulfate Zinc Oxide Zinc Chelates
Boron	Solubor Fertilizer Borate
Minor Elements	Soluble minor element mixes, many formulations available

dry granules, soluble, liquid, encapsulated and slow-release formulations. Slow-release fertilizers, popular for house plants and for use by florists and nurserymen, are not generally employed for the correction of chlorosis, because fast action is desirable.

To correct a chlorotic condition during the current growing season, most gardeners select soluble fertilizers and apply them into the soil or on the foliage. A list of common soluble fertilizers appears in Table 1. Always follow the label directions for recommended rates and uses. The fertilizers listed are usually available in garden centers or feed and grain outlets.

Methods of Fertilizer Application

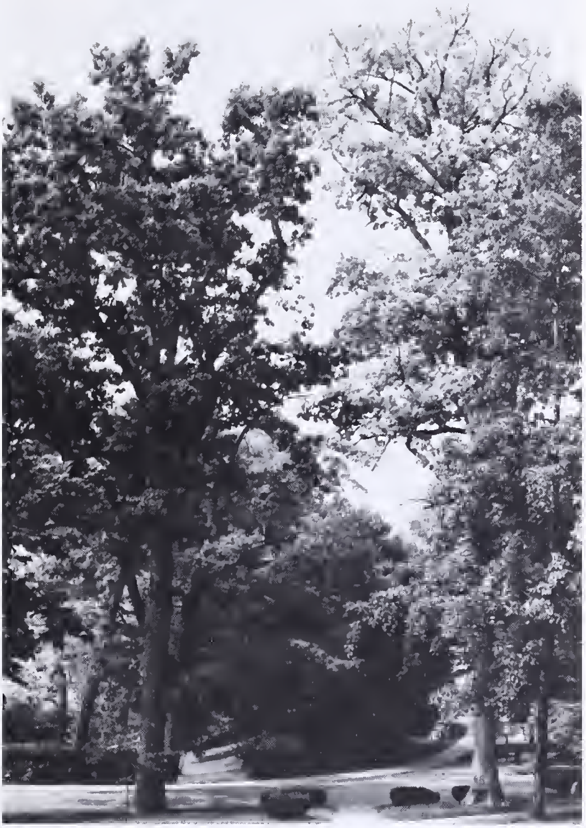
Several methods of applying fertilizer are practiced, including liquid injection into the soil, surface or drill-hole granular application, foliar sprays and trunk injection or implantation.

Liquid Injection into the Soil. Injection of liquid fertilizer into the soil results in quick absorption by the plant and is an excellent method to rapidly correct deficiencies. The addition of water to dry soil is desirable in summer or during periods of drought. Injection sites should be two to three feet apart and 15-18″ deep for trees.

Drill-Hole or Punch-Bar. In addition to fertilizing, a major advantage of drilling holes is the opening of heavy, compact soils, which provides valuable aeration as well as fertilizer. This also provides for the incorporation of organic matter, if warranted, or slow-release fertilizers. The drill holes should be placed in concentric circles in the soil around the plant, beginning two to three feet from the main stem and extending to the dripline. Space the holes two feet apart and drill the holes 15-18″ deep. Distribute the recommended rate of fertilizer uniformly among the holes. Depending on diameter of the holes, they may be filled with peat moss, calcine clay, perlite or other soil amendment.

Surface. Fertilizing via surface application is as effective with most kinds of trees as are other methods. This technique requires the least time and is the least expensive but should be avoided on lawns since it may cause turf injury.

Foliage Sprays. To correct minor-element chlorosis problems, spraying liquid fertilizer on the foliage should be considered, especially for iron deficiency. Usually two or more applications during the growing season will be necessary to prevent or control deficiencies, depending on severity. Spray applications are most effective when made just before or during a period of active growth, from spring to early summer. Late-summer treatments



L. M. Vasvary

Left—white oak treated at trunk base with implants of ferric ammonium citrate capsules. Right—untreated white oak showing typical iron chlorosis symptoms.

are less effective. This method will not provide all the necessary mineral elements in the amounts required for satisfactory growth.

Trunk Injection or Implants. Tree-trunk injection or the implant of fertilizer salts is often the most satisfactory method of applying minor elements such as iron, manganese and possibly zinc. Injection of iron sulfate has been quite effective for one season with oaks and other species. Various methods are available to inject solutions into trees. When using pressure injections, be careful not to split the bark in the vicinity of the injection site.

Trunk implants of ferric ammonium citrate capsules have been effective for two to three years in the control of iron deficiency of pin, scarlet, white and willow oak, Japanese black and white pine, sweet gum (p. 17, top) and star magnolia. Implants of magnesium sulfate have been successful in controlling magnesium deficiency in sugar, red (p. 17, below) and to a limited extent in silver maples as well as flowering cherry. Capsules should be implanted as low as possible on the trunk, in a spiral pattern and as early in spring as practical.

Chlorosis of woody plants can be caused by many factors. Determine the basic cause as precisely as possible and take corrective action. Soil and foliar analysis will be useful in diagnosing nutritional problems. Select the suggested fertilizer source as indicated on the test reports and apply according to label directions.

An answer to disease and insect problems? . . .

PLANT BREEDING FOR RESISTANCE

Frank S. Santamour, Jr.

Plants and pests have, through long periods of time, worked out a reasonable pattern of coexistence. The host plants have developed sufficient "resistance" to maintain themselves in spite of the fluctuations in numbers or aggressiveness of the native pest species. The pests, on the other hand, seldom are so successful in overcoming this "resistance" that they eliminate the plants necessary for their own survival.

Man, however, has upset this balance by moving both pests and hosts around the globe. Such movement brings about new host-pest confrontations that have often had disastrous consequences—even to the near-elimination of certain crop, timber and landscape species. The recent introduction of the coffee rust to Brazil and the problems of chestnut blight and Dutch elm disease are examples.

Man has also influenced the host-pest balance by growing plants under unnatural conditions. Thousands of acres of millions of genetically similar wheat plants per acre exert a tremendous selection pressure on the survival and subsequent spread of the rare, but successful, mutant pest. Forest trees, thrust into soil islands or peninsulas amid the concrete of our cities, may fall prey to pests that might cause little harm in rural areas. The answer to the pest problems created by growing plants where and how man desires has been provided by pesticides.

The most common question asked of a plant-insect or -disease specialist is "What should I spray to control 'X' (pest) on 'Y' (plant)?" As we are all aware, not every pest can be controlled so easily. Furthermore, many pesticides are dangerous or detrimental to the environment. Some have been legislated out of existence. More regulations concerning pesticides may be expected for years to come.

Thus it is imperative to examine more "natural" methods of dealing with pest problems. One of these is, of course, the development of pest-resistant plants. Such solutions to pest problems have proved eminently successful in annual agricultural crops. On a fairly regular basis, plant breeders vie with a wide range of pests on a large number of host plants. More often than not, the plant breeders have won the battles, but the war goes on.

The difficulties of developing pest-resistant plants are, however, more apparent when we are dealing with trees and other long-lived woody plants. These plants must endure for decades under varying and often stressful environmental conditions, usually with little care from man. Tree pests, meanwhile, may have at least one generation per year in which to reassemble their genetic arsenal against the resistant defenses of the host.

What Is Pest Resistance?

To the layman, "resistance" generally means immunity. Practically and biologically, however, resistance frequently means "less susceptible." Resistance is relative, not absolute. Plants that are resistant under one set of environmental conditions may be susceptible under another.

The ultimate susceptibility to both insect and disease pests is manifest by the death of the host plant. Resistance to lethal pests, in a biological sense, is survival—probably to sexual maturity. Generally, however, we desire not only post-puberty survival but maintenance of certain economic or aesthetic standards among the "resistant" survivors. A Nor-

One of the webworms similar to those that attack mimosa and honeylocust. Breeding of honeylocust for resistance to this pest is now in process.

Anita Sabarese

way maple tree may be "resistant" to the seemingly innocuous aphids which do not noticeably reduce the tree's growth or appearance, but the man who finds honeydew covering his car parked under the tree may consider it to be quite susceptible.

Is there a workable definition of pest resistance or does it mean what any individual says it means—at any given time or for any given situation? Pest resistance in a landscape plant may mean simply the ability to survive and provide certain amenities under a wide range of environmental conditions for a reasonable period of time.

Sources and Causes of Resistance

Where and how do we find pest-resistant plants? When an introduced pest has proved sufficiently destructive to warrant a genetic approach to pest resistance, the usual practice is to obtain related plant species or strains that have survived for long periods where the particular pest is native. Introduction of resistant plant material may be by seed or by vegetative propagation of selected plants. However, every effort should be made to obtain a wide genetic diversity of potentially resistant germ plasm. Plants from the pest's native range must, of course, be tested for resistance under the environmental conditions that prevail in the new areas where they, or their hybrid progeny, are likely to be grown.

Such an approach is not always successful. Plant species from the pest's native range are not necessarily resistant, or they may be highly variable in resistance. Then, too, they may not be adapted to the climatic conditons in their new location. As an example, we tested all available species of honeylocust (*Gleditsia*) for resistance to the mimosa webworm, which has an obscure origin in China. The Chinese species of honeylocust were no more resistant than our American ones and were not particularly well adapted to the Washington, D.C., area, where our research took place. Furthermore, the two potentially resistant species, one from Argentina and one from Hong Kong, were killed to the ground by winter cold.

Thus, our recommendation for the detection of webworm-resistant honeylocusts for landscape planting is the mass-screening of thornless seedlings of our native species in the hope of uncovering that rare individual, and perhaps more than one, that exhibits a high degree of resistance to a particular pest.

Mass-screening is also the method of choice for the selection of individual plants that are resistant to native pests. Here we have the possible advantage of being able to select individual trees, either as clones or potential parents, that have survived unscathed in the midst of disease epidemics or insect infestations.

Anita Sabarese

Japanese beetles only attack European birches if the beetle population is high; exception is *Betula pubescens,* which is highly preferred for, as yet, reasons unknown.

But we must stress again the necessity of obtaining as broad a genetic (and geographic) base of resistance as possible, and the importance of further testing to insure that the observed "resistance" is real.

For the most part, we do not know *why* most plants exhibit resistance to pests. Morphological characteristics, such as hairiness of the leaf, may be sufficient to prevent egg-laying by a particular insect. Anatomical characteristics, such as small, ungrouped vessels, have been suggested as a possible cause of resistance to Dutch elm disease. Resins, tannins, cyanogenic compounds and other intrinsic plant chemicals have been implicated in pest resistance. Then there are the phytoalexins, chemical compounds produced by the host in response to infection. Determining the causes of pest resistance is one of the most potentially rewarding, and presently frustrating, areas of research. With increasing technology and additional expenditures for research we may some day understand the bases of host-pest relationships in major plant diseases. However, we can still find resistance, determine resistance and breed for resistance even if we do not know the reasons for resistance.

Testing for Resistance

With many plant pathogens it is relatively easy to culture the organism, artificially inoculate the host plants and obtain "readings" of resistance from the induced symptoms. This procedure is followed in testing young elms for resistance to Dutch elm disease and for fire blight resistance in tree and shrub members of the Rose Family.

Certain pathogens, such as the rusts, may be difficult to culture in the laboratory. For others such as the sycamore anthracnose fungus, there is not yet a satisfactory technique for artificial inoculation. In these cases, we must rely on nature to do the screening for us. But nature seldom follows our working plan, and the scientist must try to provide the optimum biological and environmental conditions for the development of the pathogen.

Testing for resistance to insect pests seems to be more difficult than testing for resistance to disease pathogens. Insects frequently "gang up" on certain plants for no apparent reason and leave other nearby susceptible plants alone. Although the reasons for this aggregating behavior are not *apparent*, they are real, and some studies have pointed to sex pheromones (hormones) or other chemical attractants produced by the interaction of the insect and its host. Then, too, there may be hierarchies of preference among the hosts. In our birch study plots, for instance, the Japanese beetles concentrate on one of the European birches, *Betula pubescens*, while other species are only damaged significantly if the beetle populations are high.

With insects as with disease, the scientist must cooperate with nature in providing and maintaining an adequate insect population, over a sufficiently long period, to insure the efficiency of the testing procedure.

Is Resistance Inherited?

Resistance is inherited, or at least the genes responsible for the observed resistance are inherited. But often that particular combination of genes responsible for resistance may occur so infrequently that most of a resistant plant's progeny are highly susceptible to the pest. On a practical level, we are asking whether the heritability of resistance is high enough to warrant the future use of selected resistant plants as clones or breeding parents. On one hand, we must determine that the resistance is stable. We can determine this by vegetatively propagating the "resistant" plant and growing it under varying environmental conditions. Whether the "resistant" plant will produce resistant progeny, through crossing with either susceptible or resistant parents, must be determined by controlled pollination studies and long-term testing.

Other genes are also inherited. As often happens, the resistant parent or species may have horticultural or cultural deficiencies. These attributes are also passed onto the progeny. Thus, large populations or advanced-generation breeding may be necessary to recover plants that combine most of the desirable traits in a new cultivar.

Adaptability, Resistance and Pest Variability

Many pests, especially certain insects (borers, bark beetles) and various "blight" pathogens, seem to be successful only against plants that are growing at a rate far below their genetic potential. Stresses that cause such a reduction in vigor include drought, fire, soil compaction, air pollution, salt in the soil, physical injury, herbicides or other biological agents. This assemblage of stresses, and more, constitutes the variable environment of the urban landscape plant.

Breeding and selection programs designed to produce better plants for use in cities must be aware of these stresses and strive to develop plants that can endure less-than-optimum environmental conditions. By selecting and growing plants that can cope with environmental stresses, we will indirectly be selecting for resistance to a number of potentially serious insect and disease pests.

Pessimists may argue that the greater population turnover among insect and disease pests will eventually give rise to new strains that will infect or infest the "resistant" selections. Optimists can point with pride to many resistant cultivars that have proved resistant for decades. For any given host-pest relationship the duration of resistance is largely unknown. However, the more varied the sources of resistance incorporated into the resistant cultivar, the greater are the chances of maintaining this resistance.

Still, the major factor in tipping the balance in favor of the pest is the "selection pressure" that the host exerts on the pest population. Replacing *all* of our disease-killed American elms with a single resistant clone would be foolhardy. The Dutch elm disease fungus probably is sufficiently variable so that some strains capable of infecting the new cultivar would be produced. The rapid multiplication of the successful strain would insure another Dutch elm disease disaster.

In a more varied population of elms, or in areas of more varied tree species composition, the successful strain might have little competitive advantage. Thus the best way to combat the variability in the pest is to maintain variability in the plant populations—by species, by cultivars and by the diverse genetic and geographic origins of the resistance built into any cultivar.

Even in theory, given the biological facts of life, pest resistance will not solve all of our pest problems. Adding the economic facts of life may push the potential of pest resistance further down on the scale of possibilities. But pest resistance should remain a goal to be sought by everyone associated with the growing, planting and preservation of landscape plants. ⁂

ABOUT SLUGS

Louis M. Vasvary

Slugs are capable of causing extensive injury to ornamental and vegetable plants in many areas of the United States. Seedlings are especially attractive to slugs, and under home garden conditions entire plantings may be severely injured or damaged to such an extent that replanting is necessary. Young slugs rasp away at plant surfaces and often leave tiny holes covered with a thin layer of plant tissue. Older slugs will eat irregular holes through plant material. Frequently, insects are blamed for the problem; a careful inspection, however, will usually reveal slime trails, a slug's "calling card." The nocturnal habits of slugs require night inspection by gardeners if slugs are to be caught in the act of feeding. Sometimes overcast, damp, cool days will entice slugs out of concealment and home gardeners are surprised at the numbers caught in the act of feeding on favorite garden plants.

"Snails without shells" is a description often applied to slugs, and a quite appropriate definition at that because both snails and slugs are mollusks and move from one place to another on an elongated ventral organ called a "foot."

There are several types of slugs found throughout the United States and their color varies with species and age. Some common colors include black, brown, light gray, "dirty" orange, and gray with black spots. The size range depends again on species and age but the common size range in home gardens is from 13 mm (½ inch) to 38 mm (1½ inches) in length.

Slugs are hermaphroditic, which means that each individual slug has both male and female reproductive systems. Offspring are produced by cross-fertilization or mating. Usually slugs first develop male sex organs. After male development occurs, female organs can develop in addition to male organs or male organs can degenerate leaving a strictly female slug.

In areas subject to significant seasonal changes, mating takes place from August to mid-October with eggs being deposited from thirty to forty days afterward. Under greenhouse conditions mating and egg laying can be conducted throughout the year.

All slugs lay eggs. Each slug can deposit up to four hundred eggs in a year's time. The number of eggs laid at any one time may vary from two to as many as one hundred. The average is from twenty to thirty eggs. Generally, younger slugs deposit fewer eggs at one time than older slugs.

Eggs are laid in a concealed moist location such as under boards, rocks, flats, pots, or in mulch and decomposing leaves or plant debris. The greenhouse slug generally buries its eggs in tunnels beneath the soil. These cool, moist, hidden locations provide an excellent environment for protecting eggs as well as insuring their development. If hot, dry conditions are encountered, egg hatching is delayed until the weather becomes more favorable.

The round or oval eggs are about 3 mm (⅛ inch) to 6 mm (¼ inch) in diameter, colorless to milky-white with a gelatinous, watery appearance. Slug eggs may reflect or take on the coloration of surrounding materials.

Length of time for egg development and maturation of young slugs depend upon the species of slug involved. Most species overwinter in the egg stage with little or no development occurring until the following spring before the eggs hatch. If, however, favorable conditions prevail, the rate of development is accelerated and eggs can be laid in the summer for a second generation during the same year. Under high temperature and moist conditions, such as those common to greenhouses, eggs can complete their development from ten days to three weeks.

Herman Gantner

Slugs prefer cool, moist places such as the sides of terra-cotta pots and the shady parts of gardens. Their signature is the silvery trail they secrete to move upon.

Young slugs resemble adults in shape but are usually lighter in color. As soon as they hatch, slugs are capable of feeding if temperature and humidity conditions are favorable. Their rate of growth is also dependent upon temperature and humidity as well as the type and amount of available food. *Optimum* environmental conditions include humidity of 85% or more within a temperature range of 15.5°C (60°F) to 21°C (70°F). Most slugs reach full size in three months to a year.

Little is known about the maximum length of life of slugs. Under greenhouse conditions, however, where moisture and relatively high temperature persist, slugs can survive for more than a year.

Control

In order to tilt the competition between slugs and man for the same plants in favor of man, all pertinent advances of scientific technology through the ages have been utilized. Primitive man utilized such mechanical control practices as handpicking, cutting with a sharp implement, stabbing, and squashing individual slugs, a daily chore still in use today.

Domesticated birds such as ducks and geese are effective predators and have been utilized for reducing slug populations. Other animals, including various snakes, frogs and toads have been recorded as occasional predators of slugs but none are useful as a practical and effective control measure.

Sanitation has emerged as one of the key factors in slug control. The removal of tall grass, weeds, decomposing organic matter and debris adjacent to garden areas will reduce many of the favored harborages and overwintering sites for slugs. If slugs are a constant problem, special attention should be devoted to sanitation by utilizing the information known about critical factors for slug survival, especially moisture, organic matter, and favorable temperatures.

Slugs on a mushroom. Where the environment is damp and shady enough to encourage large mushrooms, slugs are almost inevitable without control. *Photo by Anita Sabarese*

The use of wood ashes, cinders, woodchips and builder's sand scattered around plants or spread in a band adjacent to plants on each side of a row has reduced feeding injury by slugs in home gardens. This technique is especially useful for protection of seedlings. After plants begin to grow, leaves and stems provide ample shelter and slugs remain on host plants rather than wandering across the soil surface.

Beer has long been recognized as an attractive food for slugs, and it can be utilized in gardens for purposes of control. Stale beer apparently has greater attractive powers than fresh beer. The beer is placed in shallow pans and situated in areas likely to be attractive to slugs. A word of caution, however: Dogs on occasion have been known to imbibe beer used for slug control; therefore, carefully secure the beer pans as well as possible. They can be covered with chicken wire screening or protected with aluminum covers with holes punched in the top.

No insecticides or fungicides have given consistent slug control. During the 1930's a chance observation led to the discovery of metaldehyde as a slug control chemical. Metaldehyde was one of the principle ingredients in "Metafuel" or "canned heat" and it was observed that slugs exposed to metafuel were soon killed.

Metaldehyde is available as a pelletized bait, dust and in liquid formulations. Baits are often used, but they tend to get moldy quite rapidly and should be replaced at frequent intervals because moldy baits lose their attractiveness for slugs. Metaldehyde baits can be used in ornamental plantings and edible crop plantings if the material does not come into contact with edible portions of the plant. Therefore, metaldehyde baits should be placed around the perimeter of the garden and on soil between rows or under flat boards. Incidentally, many gardeners place flat boards in their vegetable gardens to provide a favorable retreat for slugs. Then during the day the boards are turned over, exposing the slugs to the full wrath of the gardener.

When using metaldehyde baits in hot, dry weather, it is helpful to wait until evening, scatter the bait, then sprinkle the area with water to activate the slugs. Remember when using baits, do not form or place the bait in piles because it may be attractive to dogs or cats.

Slug tolerance to metaldehyde seems to be increasing, so some formulators have added other ingredients to their baits. Carefully read the label *before* applying baits to garden areas.

Experiments have shown that some carbamate materials such as methiocarb (Mesurol) are equal to or more effective than metaldehyde. A 2% pelletized brand bait of methiocarb (Mesurol) is now available and has given faster and greater slug control than standard metaldehyde baits. The bait is registered for use only in ornamental plantings. Methiocarb (Mesurol) is *not* registered for use in vegetable plantings at the present time.

In addition, there are commercially-prepared sprays, dusts, and foam sold for slug control. **Read the label** and follow directions for their use. ☙

What and where they are,
and what to do . . .

PLANT NEMATODES

J. T. Walker

Perhaps the only known *animals* which cause plant diseases are so small that most cannot be seen by the naked eye. These organisms, termed nematodes or eelworms, result in plant infections world-wide. There may be as many as a half-million different kinds, yet only about four dozen genera are important plant parasites.

Nematodes are worm-shaped, most kinds ranging in length from 0.5 mm (1/50 in.) to 2.0 mm (1/12 in.). The majority are only .15 mm to .20 mm in diameter.

Many nematodes are not parasitic or pathogenic on plants; some are parasitic on animals, including man. Others are not parasitic at all, living in the sea, sand or soil. Their feeding habits and habitats vary as does their physiology. It is thought that almost any organism may serve as a source of food for one kind of nematode or another.

All nematodes have sensory organs and nervous systems. All live in water, or in a thin film of water around soil particles, moving about by contracting and relaxing their muscles. Some can withstand desiccation. Many are capable of assuming a low state of metabolism or quiescence under stress conditions. Nematodes respond to temperature, light, soil type, pH, gravity, moisture and chemicals liberated from the microenvironments of living roots.

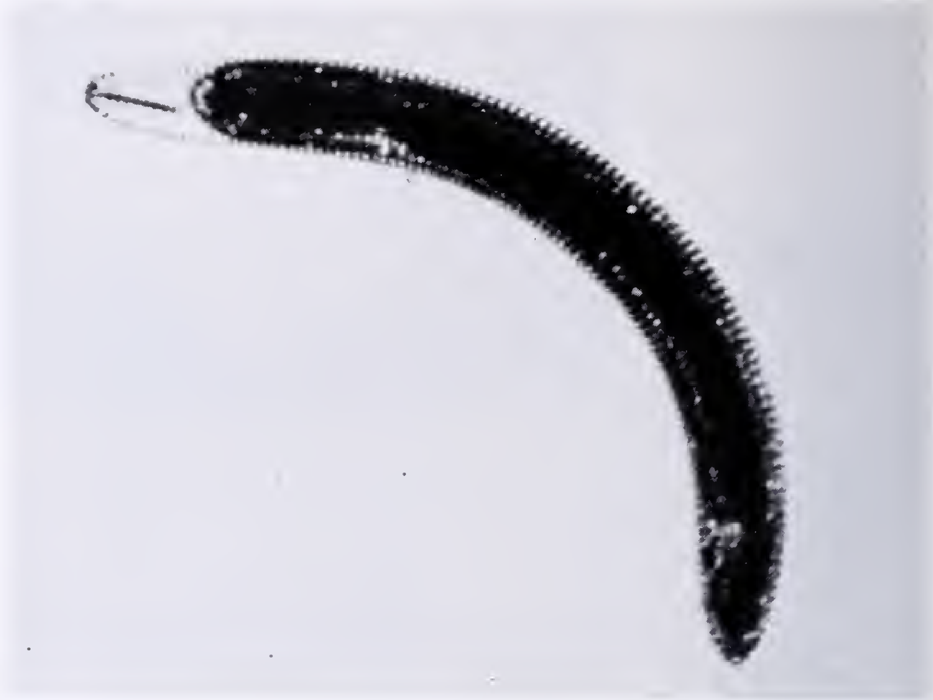
Plant-parasitic Nematodes

The nematodes which are harmful to plants can be characterized by their feeding habits. Most of these attack roots or below-ground plant parts; a few migrate to leaves and stems. Those which feed on the root surfaces without complete entry are termed *ectoparasites*. Those entering roots completely are called *endoparasites*. Both groups at some point can be migratory (moving about, feeding without becoming attached) or sedentary (becoming attached, and not moving about).

All plant-parasitic nematodes possess a hollow, protrusable spear or stylet which is used to puncture plant cells. A median bulb acts as a pump to inject saliva or withdraw cell contents during feeding.

The type and extent of root damage depends on the species of nematode, the plant and the nematode population. Generally, roots have abnormal growth (stunted or enlarged) as the result of nematode attack. Root-knots or galls are enlargements caused by the feeding of root-knot nematodes, perhaps the most common nematode recognized in home gardens. Lesions appear as areas of darkened tissue after nematodes have been feeding. Sometimes the lesions encircle the root, impairing its function. Another root symptom is excessive branching in the area of nematode activity. Nematodes often feed just behind the growing root tip, resulting in shortened stubby roots. Some nematodes migrate to aboveground plant parts and cause dead areas of leaves and distortion of stems.

Although the feeding activities of these transparent worms cause mechanical damage to plants, the greater effects are from the chemicals which are injected by the nematodes, resulting in changes in the plant's metabolism. Nematodes are also carriers of certain plant viruses, and can be the means by which other disease organisms gain entrance to the plant. For instance, one of the common wilt diseases of tomato is caused by the fungus called *Fusarium oxysporum*. When the root-knot nematode is present along with the fungus in the same soil, the disease is accentuated. It is thought to be more than a mere wounding effect by nematodes, although, in themselves, they can be very effective in reducing water and nutrient uptake by damaging the roots.



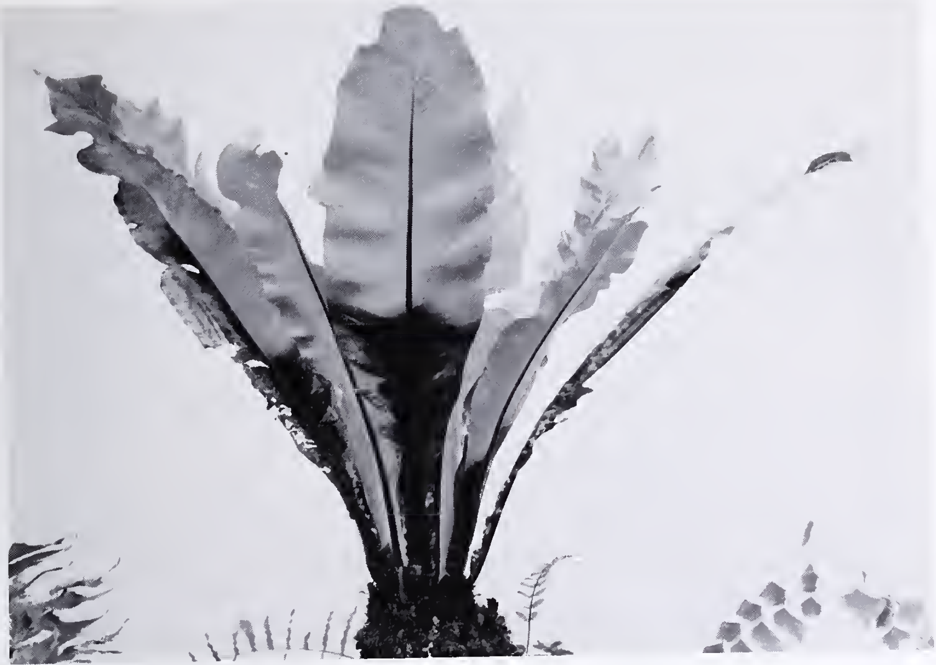
Photos: L. M. Vasvary

An ectoparasitic ring nematode showing the stylet typical of this nematode (approximately 180%).

Diagnosis

How can you determine if nematodes are a problem in your garden? Not all plants are affected similarly because nematode populations vary from plant to plant. Also, plants differ in their susceptibility to different nematodes. Stunting of plants is one symptom commonly observed; the plant frequently will wilt under drought stress when roots are damaged by nematodes, but this can result from other pathogens as well. In terms of crop yields, nematode-infested plants usually yield less than noninfested plants. Sometimes, nutrient deficiencies occur in the infested plants, resulting in yellow foliage; other times nutrient excesses result. Leaf necrosis, a browning-then-dying of leaf tissue, occurs where above ground parts are subjected to leaf-invading nematodes. These particular nematodes can be found in chrysanthemums, begonias, ferns and many foliage plants. Generally, if no other pathogen or physiological problem can explain poor plant growth or symptoms observed, then nematodes should be suspected as the probable cause.

Except for the commonly observed root-knots found on many plants, a reliable diagnosis for nematodes can be achieved only if a soil sample is analyzed for kinds and numbers of nematodes present. It is advisable to include living roots as part of the sample to determine if endoparasitic species are present. The time to have samples examined depends on the advisory service in your locality. For problem plants, have samples tested at different times. Nematodes are most active and numerous toward the middle or end of the growing season. Usually your County Extension Office can advise you where and when to submit the samples. You will receive a report on what nematodes were present along with control recommendations for specific crops or plants if you provide information on the plants when you send in the sample.



Injury to leaves of birds nest fern (*Asplenium* sp.) by an endoparasitic foliar nematode.

Control

There are four broad means—cultural, biological, physical and chemical—of nematode control. In the vegetable garden, if possible, practice rotation, either by planting in different areas from year to year or by using different plants in the same area. Keep an area fallow (unplanted) for a year or more, as plant-parasitic nematodes will starve in the absence of hosts (including weeds). In spite of nematode attack, proper fertilizing, while not affecting the nematodes directly, helps maintain plant vigor. Sanitary practices should always be followed. Don't bring soil, plants or equipment into your garden from other regions. Examine transplants carefully for root lesions or knots and, if present, avoid purchase.

For biological control, use resistant cultivars whenever possible. Check seed catalogs closely. The VFN designation of some tomato cultivars means they are resistant to certain strains of verticillium (V), fusarium (F) and the common root-knot nematode (N).

Adding organic matter to the soil can be partially effective in keeping nematodes in check, because this encourages the development of predacious nematodes, fungi and bacteria which feed on or trap the plant parasites. Microorganisms can also produce substances toxic to nematodes. Planting trap crops, such as certain types of marigolds or chrysanthemums, can be useful for small garden areas if plantings are intensive, covering an entire area.

Soil sterilization or pasteurization by heat are examples of physical means for nematode control. These methods are important for greenhouse operations or starting seed in noninfested soil for later transplanting to the vegetable garden.

In farm crops the most significant method of nematode control is by chemical means. This practice has some applicability to the vegetable garden as well, but the chemical choices are very

NEMATICIDES

Many are for restricted use only.
Check with Extension Service representative in your area.

Chemical	Trade name	Chemical composition	Toxicity	General use information
methyl bromide (MB)	Dowfume MC-2	98% gas	High	Wide spectrum fumigant; Cover required
methyl bromide + chloropicrin	Terr-O-Gas 67	67% 32%	High	Broad spectrum fumigant
ethylene dibromide (EDB)	Soilbrom 90 EC Soilbrom 85 Soilbrom 40 Dowfume W-85	90% EC 85% L 40% L	High	Liquid with fumigant action
ethylene dibromide + chloropicrin	Terr-O-Cide 30 Terr-O-Cide 72-27	36% L 30% 72% 27%	High	Broad spectrum soil fumigants
oxamyl	Vydate L	24% L	High	Nematode + insect control on certain ornamentals
1,3,-dichloropropene	Telone 11	92% L	High	Preplant fumigant nematicide
aldidarb	Temik	10% G 15% G	High	Contact nematicide for use on some field & ornamental crops
carbofuran	Furadan	10% G	High	Nematode and insect control
ethoprop	Mocap	10% G	High	Granular or liquid nematicide/insecticide
phenamiphos	Nemacur	15% G	High	Granular or liquid nematicide
fensulfothion	Dasanit	15% G	High	Granular nematicide (contact)
1,3,-dichloropropane, 1,2,-dichloropropene	D-D	100%	High	Liquid fumigant
metam-sodium	Vapam	32.7% L	Slight	Liquid fumigant

limited. Most nematicides are applied as preplant treatments. Most must be applied two-to-three weeks prior to planting and with specialized equipment. Certain ones, called fumigants, operate in the gaseous state, killing weed seeds, fungi and insects as well as nematodes. Nematicides are formulated as dry granules, liquids or as gases. Liquids or granules must be placed or worked into the soil, either as a broadcast or furrow treatment.

Very few nematicides are for home gardens; most are "restricted-use," highly toxic materials, to be employed by only professional, licensed applicators. Although systemic nematicides may someday be effective for killing nematodes within growing plants, most currently available are effective only when used for dipping plant material.

In summary, nematode control by chemical means is not very practical for the average gardener but may be vital to the commercial grower. All control methods available should be utilized as much as possible by both farmer and home gardener in order to keep plant-parasitic nematode populations at a manageable level. If it becomes necessary for the gardener to apply soil nematicides, then the specific recommendations for his locality should be obtained from the extension service representative. ❧

Why the aster doesn't grow . . .

MYCOPLASMA AND THE YELLOWS DISEASES

Tseh An Chen

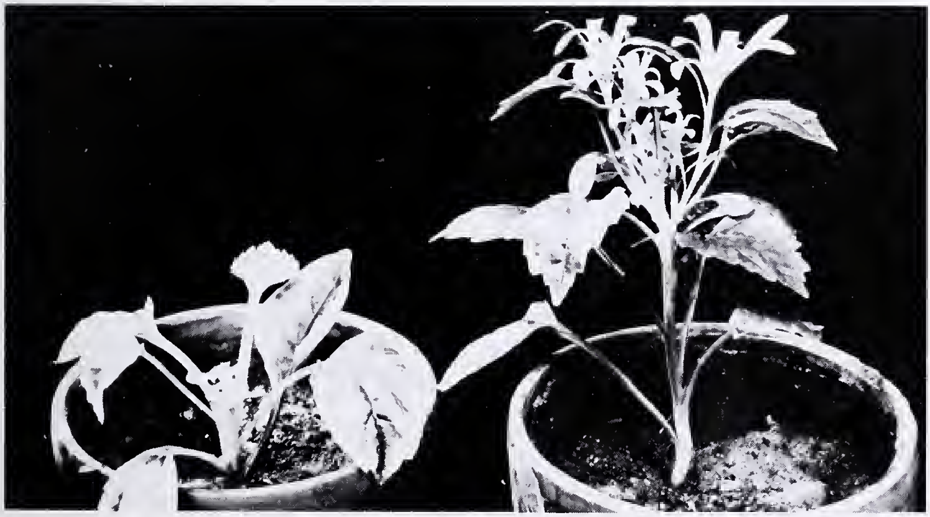
A group of plant maladies commonly known as "yellows" diseases affects many economically important horticultural and food crops. In the flower garden the "yellows" disease may be found on aster, anemone, calendula, coreopsis, cosmos, delphinium, daisies, hydrangea, marigold, petunia, phlox, strawflowers and others. It is also a disease of carrot, lettuce, potato, tomato, spinach and other vegetable crops. Aster yellows has been known since 1902 and is considered typical of this group of diseases. Infected plants are characterized by stunted growth, yellowing of the foliage and proliferation of lateral buds and roots that produce witches' brooms and excessive roots respectively. Flowers revert to leaf-like organs, resulting in sterile plants or aborted seeds. The organisms causing yellows diseases are spread in nature by certain leafhoppers and psyllids.

Yellows diseases have long been thought to be caused by viruses. This is based on the fact that the infectious agents can pass through filters which retain bacteria but not viruses, and that the disease is graft-transmissible. However, all attempts to isolate viruses from such infected plants have been unsuccessful, and virus particles have not been observed in diseased plant tissues by electron microscopy.

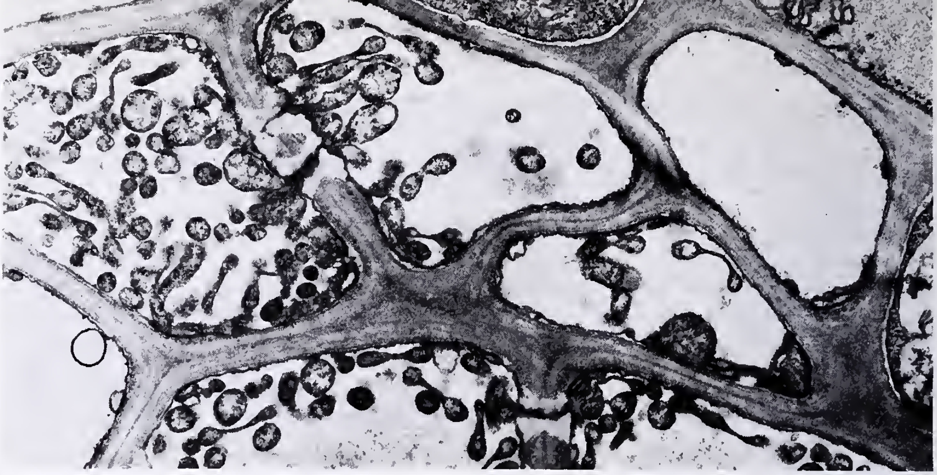
Research Findings

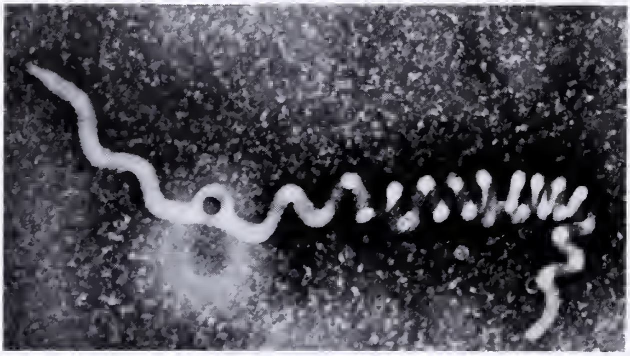
In 1967, Japanese scientists reported that certain yellows-type diseases, such as potato witches' broom, aster yellows, paulownia witches' broom and mulberry dwarf, may be caused by microorganisms resembling mycoplasmas. These microorganisms were observed by electron microscopy in the phloem tissue of diseased plants but not in healthy ones. Further, these microorganisms were shown to be sensitive to certain antibiotics such as tetracycline and chlortetracycline (Terramycin and Aureomycin), which is characteristic of mycoplasmas. Japanese scientists found that when yellows-infected plants were sprayed with these antibiotics, disease symptoms disappeared. However, when antibiotic treatments were discontinued disease symptoms reappeared.

Left—China aster with aster yellows; right—healthy plant.



Photos: T. A. Chen





Above—microscopic view of mycoplasmalike organisms in sieve tubes of diseased Bermuda grass. Left—spiroplasma from corn stunt disease as seen magnified 19,000 times.

Since 1967, more than one hundred different plant diseases have been reported to be associated with mycoplasmas. Thus, beside fungi, bacteria and viruses, plant pathologists are facing a new challenge—the mycoplasmas.

Mycoplasmas are the smallest cellular organisms. They were first isolated in 1898 and proved to be the causal agent of a pneumonia-like disease of cattle. Later, mycoplasmas were also found to infect sheep, pigs, dogs, poultry and man, where they cause infections of respiratory and genital organs. They have been known to be infectious to plants only since 1967. Mycoplasmas have no particular shape because they have no cell walls. The cell of the mycoplasma is covered by a thin cell membrane. Most animal mycoplasmas can grow and reproduce on artificial media in the absence of a host. The mycoplasmalike organisms found in plants are similar to those isolated from animals. They grow and reproduce in the food-conducting tubes (sieve tube) of the plant. Mycoplasmas not only compete with the host plant for food but, as they multiply, they probably produce toxic substances or interfere with plant hormones which are needed in regulating growth and development of the host plant.

Unlike the mycoplasmas infecting animals it is extremely difficult to isolate and artificially cultivate these mycoplasmalike agents from plants showing yellows-type symptoms. To date, only the agents causing citrus stubborn and corn stunt disease have been successfully cultured. These microorganisms, however, differ morphologically from all known mycoplasmas. Their shape is like a piece of coiled telephone cord (helical) and they move by flexing and twisting. Despite their structural differences these helical organisms are still considered to be a type of mycoplasma, but because of their characteristic shape they are called ''spiroplasmas.''

Since the discovery of spiroplasmas scientists have found these helical organisms associated with white leaf disease of Bermuda grass, yellow dwarf disease of rice, decline of pear, Western X of peach and witches' broom of cactus. Spiroplasmas have also been found to cause sterility of certain fruit flies and death of honeybees. Since they have been found in the nectar of several flowers, it is reasonable to speculate that they are disseminated from insect to insect through the nectar. Recently a spiroplasma isolated from rabbit ticks was found to cause cataracts on newborn mice and rats. Thus, these new, helical mycoplasmas are widely distributed in nature and are proving to be important disease-causing agents of plants, insects and vertebrate animals. Someday, not too surprisingly, scientists may find spiroplasmas as culprits of certain human diseases.

Control

Because spiroplasmas are similar to mycoplasmas, their growth and multiplication can also be inhibited by tetracycline antibiotics. Presently, antibiotic treatments are the only chemotherapy known for yellows diseases. For annual herbaceous plants, foliage spraying with antibiotic solution or their administration to the root system may achieve temporary recovery from the yellows symptoms, but repeated applications are necessary to prevent recurrence of symptoms. On the other hand, a single, yearly injection of antibiotics in pear and peach is sufficient to keep them growing normally and producing good yields.

High-temperature treatment is an effective control of mycoplasma disease of plants. Immersing bulbs, tubers, and root cuttings in water 109-122°F (43-50°C), depending on plant species, for ten minutes can completely eliminate the mycoplasmas in plants. Since high temperatures may damage plants, repeated treatments with shorter exposure time are recommended. Infected root stocks, scions or nursery plants can be grown in plastic houses equipped with a small steam generator so that a temperature of 104°F (40°C) can be accurately maintained. Again, less plant injury occurs when several treatments of short duration are used rather than a single prolonged exposure. It has been shown that complete remission of yellows disease is possible when plants are grown at a temperature of 104°F for twelve hours a day for one month.

Selecting and growing mycoplasma-resistant plant species and cultivars is the ultimate goal in combatting yellows diseases. Research in this area is just beginning. In the meantime, plants may be protected from mycoplasma infection by eliminating or reducing their insect vectors. Also, plants suspected of being infected should be destroyed to effectively prevent spread of yellows diseases. ⁂

Control of Lawngrass Diseases

What spray should be used on lawns to control disease? That depends upon the kind of grass and the particular disease. Many home gardeners can identify diseases of garden plants and control them with a few appropriately timed sprays with the proper material. Lawngrass diseases are not so easy to identify or control.

The good golf course superintendent may apply fifteen to twenty fungicide sprays a year. He starts in April with sprays for leafspot and ends in November or December with sprays to prevent snowmold.

If you want to undertake a complete lawn disease control program, then write the U.S. Government Printing Office in Washington for their beautifully illustrated "Lawn Diseases—How to Control Them." You can also contact your state university or county extension agent for current recommendations on the approved chemicals for lawn diseases. And after you have treated your lawn for disease, you can start on lawn insects and their control!

But before you decide to go into any disease and insect control program, we suggest you obtain the Brooklyn Botanic Garden *Home Lawn Handbook* (#71) and follow suggestions for making and maintaining a good lawn. ⁂

Keep them fit . . .

HOW MUCH DO HEALTHY TREES INCREASE PROPERTY VALUES?

J. James Kielbaso

Have we not all heard a homeowner claim to have paid extra, $2,000 or more, for a property with trees? Wooded lots in new subdivisions not uncommonly sell for over $5,000 more than treeless lots. Some developers charge between ten percent and fifteen percent more for similar homes on properties with trees. Lots with trees are usually the first to sell in newly developed areas, even with higher price tags.

Research by Brian Payne of the U.S. Forest Service has demonstrated in surveys that trees contribute an average of seven percent to the value of a half-acre home site and, to some as much as fifteen percent. He showed that on open land trees contribute as much as twenty-seven percent of the appraised land value. As a 1973 example, he chose for comparison two similar eight-room French Provincial homes—the one on treeless site appraised at $39,000, the other on a wooded site appraised at $44,400, more than thirteen percent higher. The same study showed that on half-acre sites each tree, up to the twenty-ninth, added some value to the property, but further trees reduced it. In this study, only trees over six inches in diameter had this effect.

Beyond having trees on your property, and noting sales differences, what else may be a factor in determining the actual values trees have? Climate modification may be considered. Depending on the source, we hear claims that a large tree is equivalent to as few as five, and as many as a hundred or more, air-conditioner units. A study of Alabama mobile homes determined electricity-cost savings in air conditioning and attributed it to shade from trees. It found each tree to save $88 each year. With rising energy cost this value is probably over $100 today. At six percent interest, it would require over $1400 to earn this much each year.

Evaluation Method

Several approaches have been used in the past for attributing value to individual trees. The currently most accepted method is that developed by the International Society of Arboriculture in cooperation with the National Arborist Association, American Society of Consulting Arborists, and the American Association of Nurserymen.

Briefly, this method employs a formula:

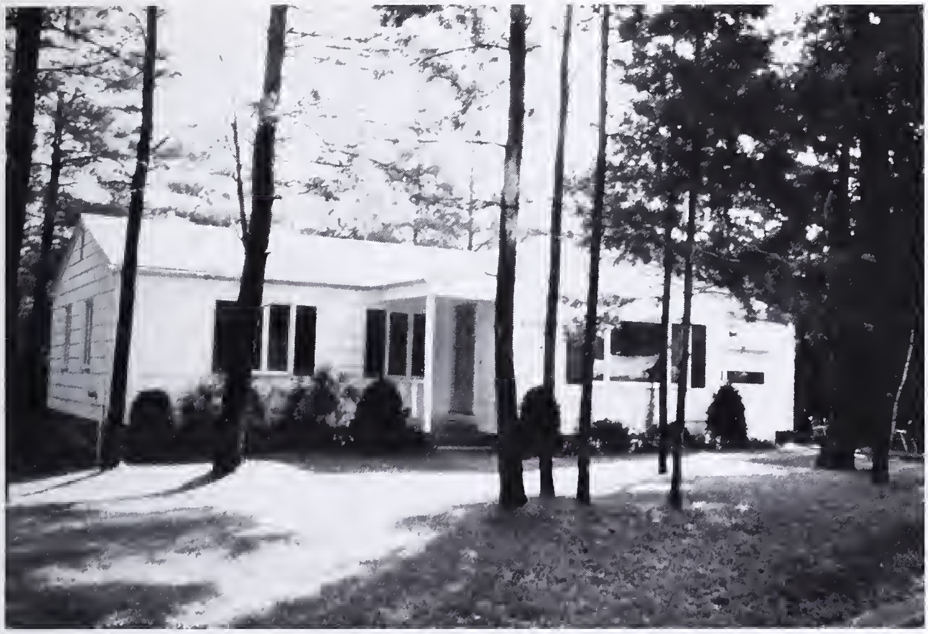
Tree Value = Basic Value x Species
x Condition x Location

Basic value is expressed in dollars based on the diameter of the tree. The other factors are expressed as percentages, representing the actual tree being evaluated compared with an ideal tree. Basic value is the value related to the size of the tree—for instance a tree fourteen inches in diameter is valued at $2770. This value is obtained by determining the tree's cross-section area in square inches and multiplying by the appropriate value per inch, currently $18. A twenty-inch tree's value is $6235 and the value of a thirty-inch diameter tree is $12,725.

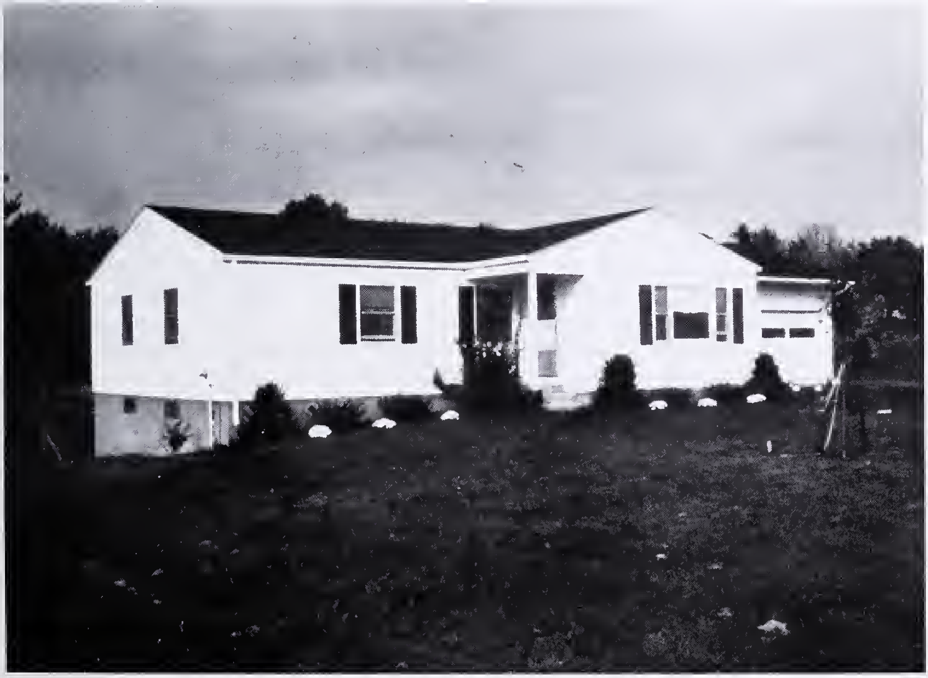
Trees smaller than thirteen inches in diameter are usually considered replaceable, and therefore replacement cost for a similar tree is preferred to the above method. Some guides are provided, however, for average prices for replacement. As examples, a two-inch diameter tree could be replaced for between $65 and $80 per inch, or about $140; a five-inch tree for between $85 and $110 per inch, or about $485; a ten-inch tree for between $120 and $160 per inch or about $1400.

Species value is a factor used to represent the relative value of the tree species. A very "good" species would be valued at one hundred percent and the "poorest" species at perhaps zero. The appropriateness of a species varies from place to place across the country, gener-

Photos: Brian Payne



Above, the developer left a number of trees on the property, while below the land was completely cleared. The houses are identical but the evaluation of the wooded site in 1973 was $40,400, while the other was $38,000.



ally following the hardiness zones, though not necessarily. Condition value and location value are in some ways related, but "location" specifically refers to the appropriateness of the location in the landscape whereas "condition" refers to the relative physical/biological well-being of the tree in question.

An untrained person cannot accurately observe and rate such characteristics as insects, disease, branching habit, decay, condition of the soil in which a tree is growing, and many other important considerations. A local person with experience and training will be able to accurately identify the tree, know if it is a good species for the area, the problems common to it, and know what to expect from its use in the landscape. Members of several groups, notably the ones mentioned above, are especially qualified to make such judgments. Others may also have appropriate knowledge, but members of these professional organizations specialize in tree-care problems and take part in educational seminars to improve their skills.

Keep it Healthy

Just as the presence of trees increases property value, so, too, the health of the tree increases its individual value. Maintaining the tree in a healthy, vigorous condition helps the tree ward off many insect, disease and environmental problems that might otherwise render it a liability, or even a hazard.

A tree rated in excellent condition would normally be expected to live over thirty years and would receive a percentage rating of ninety to one hundred. An example of the use of the formula may be of assistance. Consider an American beech, in general regarded as an excellent species in the North and thus often rated as one hundred percent as a species. If it is twenty-three inches in diameter, the basic value is $7482, based on the cross-sectional inches multiplied by $18. This $7482 Basic Value is then multiplied sequentially by the other factors. Since the species is "excellent," or one hundred percent, the value remains $7482. Suppose the tree is growing in a good, average residential location, which is usually assigned a value of eighty to ninety. For this example eighty percent will be used. Now, $7482 x .80 = $5985. One last factor remains—condition. Suppose that after careful examination in which reduced growth rate, a large cavity in the trunk, and several dead branches are found, the tree is rated as only fair and a fifty percent condition value assigned. The value is determined as: $5985 x .50 or $2993.

In this example, the evaluator would assign a value of $2993 for the American beech. Obviously, this is a simplified case. Many factors must be considered when determining the condition, as well as the location factor. The appraisal expert should take all factors into account, based on training and experience, before establishing a value.

The homeowner has much to do with maintaining one of the evaluation factors at a high level. Once a species is planted in a particular location, the factors of species and location are fixed rather permanently. Various species have average growth rates which can be affected to some extent by maintenance practices, but in large part size is dependent on age. Perhaps the factor which can be influenced most is condition. By proper care and maintenance the tree may be kept in excellent condition, or on the other hand, allowed to deteriorate.

Realizing that the condition of a tree has great importance in determining its value, homeowners who maintain their trees in the most healthy condition possible also enhance their property values to the maximum. Trees in unhealthy condition will have much less value and may possibly become a liability.

Much more could be said regarding the other benefits of trees, such as shade, noise control, climate control and just pure beauty or aesthetics. The fine points of shade tree valuation have only been briefly touched upon. Because trees do add value to property when well cared for, healthy trees are a definite asset to the investment made in a home. When properly cared for, trees increase in value and contribute to value for many years. ☘

What every homeowner should know . . .

QUESTIONS AND ANSWERS ON TREE DECLINES

Craig R. Hibben

What is meant by tree declines?

Decline, or dieback, is a progressive deterioration of forest and ornamental trees for which there is more than a single cause. Another definition—a complex disease causing the gradual death of trees. An example is maple decline. The Dutch elm disease is not a decline because it is caused by a single agent, a fungus, and infected elms die rapidly.

What does tree decline look like?

The first abnormality is slower growth. Twig elongation and annual ring thickness in the sapwood become reduced. As twigs grow more slowly the foliage becomes clumped and the leaf canopy is less dense. Mature leaves are small and yellowish. Marginal scorch, early autumn coloration and premature leaf fall sometime occur. Branch tips die, usually during the dormant season, and the dieback progresses inward and downward in succeeding years.

Although not visible, a reduction in food reserves, especially carbohydrates, in the roots, accompanies the gradual dieback. In the late stages before death, trees have a stag-headed appearance caused by dead branches, and sprouts often develop along the trunk and main branches.

What basically are the causes of tree declines?

Decline begins after some adverse change in the tree's environment. Attacks by disease agents follow. The symptoms described above reflect the general tree response to such major stresses as drought, insect defoliation or urban-generated air pollutants, compounded by the invasion of various secondary disease organisms, usually fungi. These opportunistic fungi can only attack a host already weakened by some other stress.

Decline severity is dependent on the magnitude of the environmental stress plus the virulence and population of the secondary invaders. Because tree declines are often triggered by wide-ranging environmental change, such as a regional drought, they occur over a large geographical area. For example, ash dieback affects white ash through much of its natural range in the northeastern United States. It is noteworthy that many tree declines occur in the Northeast, with its density of cities and history of repeated drought.

What trees are affected and where does it occur?

The major declines affect deciduous trees in the eastern half of the country. Ash dieback continues to cause mortality of white ash (*Fraxinus americana*) and, to a lesser extent, green ash (*F. pennsylvanica*) in the Northeast and in southeastern Canada. For unknown reasons, ash dieback has been most severe in the southeastern Hudson Valley region of New York State. The main causes appear to be drought followed by invasion of the bark by canker fungi. Recent research has shown that air pollutants and virus infection may also contribute to the dieback.

Maple decline is of two types. Sugar maples (*Acer saccharum*) in Wisconsin and other Great Lakes states, and recently in the Northeast, have suffered severe insect defoliations followed by root rotting by a soil-borne fungus, *Armillaria mellea*. More noticeable has been the widespread dieback of roadside sugar maples, which were once extensively planted along roads throughout the Northeast. The salting of roads in winter and planting in restricted sites disadvantageous to shallow-rooted maples have contributed to sugar maple weakening and dieback.

C. R. Hibben

Ash decline at its severest.

The beech bark disease, caused by two scale insects (*Cryptococcus fagi* and *Xylococculus betulae*) and a canker fungus (*Nectria coccinea* var. *faginata*), continues to kill American beech (*Fagus grandifolia*) throughout the New England states, New York and Pennsylvania. The same root-rotting fungus, *Armillaria mellea*, provides the *coup de grâce* to many beech trees with the bark disease.

In large areas of Pennsylvania, West Virginia and, recently, in sections of New York and Connecticut, oaks, primarily red oak (*Quercus rubra*) and scarlet oak (*Q. coccinea*), show mortality from the combined effects of insect defoliators and borers, drought, late-spring frosts and root-rotting fungi. Oaks in poor sites, especially on southern and western slopes, along ridge tops, and in shallow, well-drained soils, are more prone to decline. A contributing factor inimical to oaks in the midwestern states is the often impervious layer of calcium-rich subsoil. Oaks thrive in acidic, well-drained soils.

Since the 1930's birch dieback has been severe in yellow birch (*Betula lutea*) and paper birch (*B. papryifera*) in southeastern Canada and northern New England. By 1945, up to eighty percent of the marketable birch was killed. Some remnants of birch dieback remain today. Although this decline problem has been studied more than any other, the exact causes remain unknown. It appears to be a response to the combined effects of water deficiency, increased soil temperature, insect defoliators and borers, and possibly virus infection.

Sweetgum blight has affected forest stands of *Liquidambar styraciflua* over much of its natural range in the southeastern United States since the 1940's. The causes remain unknown.

Are there control measures?

The complexity and interaction of the various climatic and biological stresses that lead to declines make them especially difficult to diagnose and control. Curing declining trees is less likely to succeed than control by prevention. This applies particularly to high-value shade and ornamental trees that can more easily be reached and treated than forest trees.

Control recommendation may be summarized as follows: 1) Decline problems can be minimized by planting trees known to be tolerant of a wide range of conditions. There are numerous excellent new cultivars available from nurserymen. 2) Avoid sites which are unfavorable to tree roots. Examples are roadside locations and heavily-compacted soils. 3) Minimize disturbances to the tree site, *e.g.*, land fill over roots, cutting major roots, application of weed killers. 4) Maintain a program of watering, fertilization, insect and disease control and pruning and mulching to assure tree health. 5) Plant or encourage a natural mixture of trees to reduce the impact of a severe decline in any one species.

Research on tree declines is being intensified by the U.S. Forest Service. Better methods of early detection, as well as the clarification of how various environmental stresses and disease organisms interact, are being investigated. This work promises to yield information for more effective control measures. ⁂

There are a number of . . .

TREE PROBLEMS NOT CAUSED BY PESTS

Francis W. Holmes

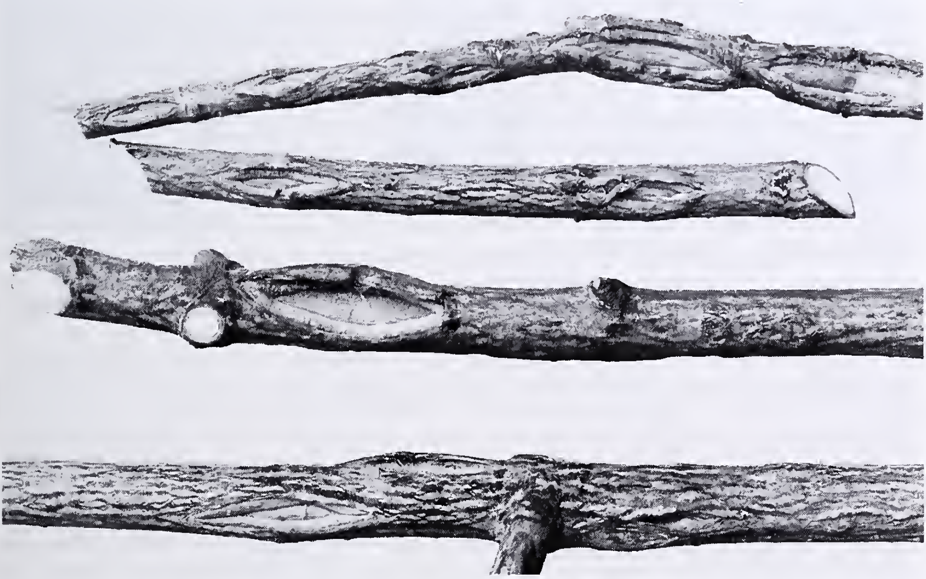
Shade trees, particularly in urban areas, are subject to not only all the diseases they would meet in the forest, but also to stresses and injuries caused by people, by summer heat and drought, and by less suitable soil. Because the average person has more concern for the trees that grow nearest home or work, a greater value is placed on individual trees in cities and towns than for ones in the wild. Therefore, it pays to take care of them. Some common problems, grouped under five headings—weather, soil, chemicals, other human-caused problems, and competition—follow.

Weather

Scorch. *Symptoms:* Brown, dead leaf margins (edges) and areas between veins. Green tissues border the veins; sometimes leaves are cupped. *Cause:* Scorch is found with many injuries or diseases of trunk or roots. It means that leaves lost water too rapidly. *Treatment*: Loosen compacted soil, remove pavement or fill, apply a mulch. With fertilizer, emphasize potassium, *e.g.*, 5-10-10. Water during dry weather. Plant in sites sheltered from wind or afternoon sun.

Sunscald. *Symptoms:* Dead or cracked southwest patches, open to infections, on young, thin-barked trunks. *Cause:* Bark was overheated in summer or exposed to sudden hot sun in winter. Common on trees exposed by transplanting or by removal of other trees. *Treatment:* Cut out affected surface tissues during dry weather. Wrap the bark of transplanted trees with heavy paper or burlap, or coat with whitewash (not oil paint), or even lean a broad board on the southwest side. If you must prune severely, thin the crown gradually over several years.

Frost Crack. *Symptoms:* A long crack opens in the trunk or a major branch, especially in thin bark and on the south or



Photos: R. L. Caffin, U. of Mass. Shade Tree Laboratories

Hail injury to Norway maple. Fortunately the tree was healthy enough to form callus tissue to heal the wounds.

southwest side. When it occurs it may sound like gunshot. Later, sap may run and attract insects, and infections can occur. Over several years, a ridge of callus tissue develops along the crack if tree is healthy. *Cause:* A sudden drop in air temperature, when a warm day in winter is followed by a "cold snap." Wood is expanded in the warmth; in the cold, water moves out of cells and freezes, then the dried outer layer shrinks sooner than the core and cracks like sun-dried lumber. Some cracks may occur at right angles to old scars or wounds as a result of pressure from ridges of healing callus, but we also have seen cases without the presence of old wounds. Old cracks can reopen in very cold weather even without rapid drop in temperature. *Treatment:* Cracks that re-open may be bolted. This surgery requires a professional arborist.

Late Frost Injury. *Symptoms:* Young, expanding foliage and/or swelling buds are killed. Injured leaves may have scorch-like symptoms. Leaves from injured buds have tattered lines between their major veins. When most foliage is frost-killed, a second set of leaves may develop, depleting food reserves. *Cause:* Frost in the early days of the growing season. *Treatment:* Fertilize in early spring or late autumn but not in summer (to avoid frost injury to unhardened tissues in autumn). Remove dead branches and dress the resulting wounds.

Heavy Snow or Ice. See Mechanical Injuries.

Winter Injury. *Symptoms:* Certain branches or the entire tree fail to come into leaf or to bloom in spring. The wood then may rot or be attacked by parasites. With slight injury, leaves may be small. *Cause:* Extreme cold in midwinter may kill roots, twigs, buds, bark, cambium. *Treatment:* Same as Late Frost Injury. Mulching prevents or reduces freezing of roots.

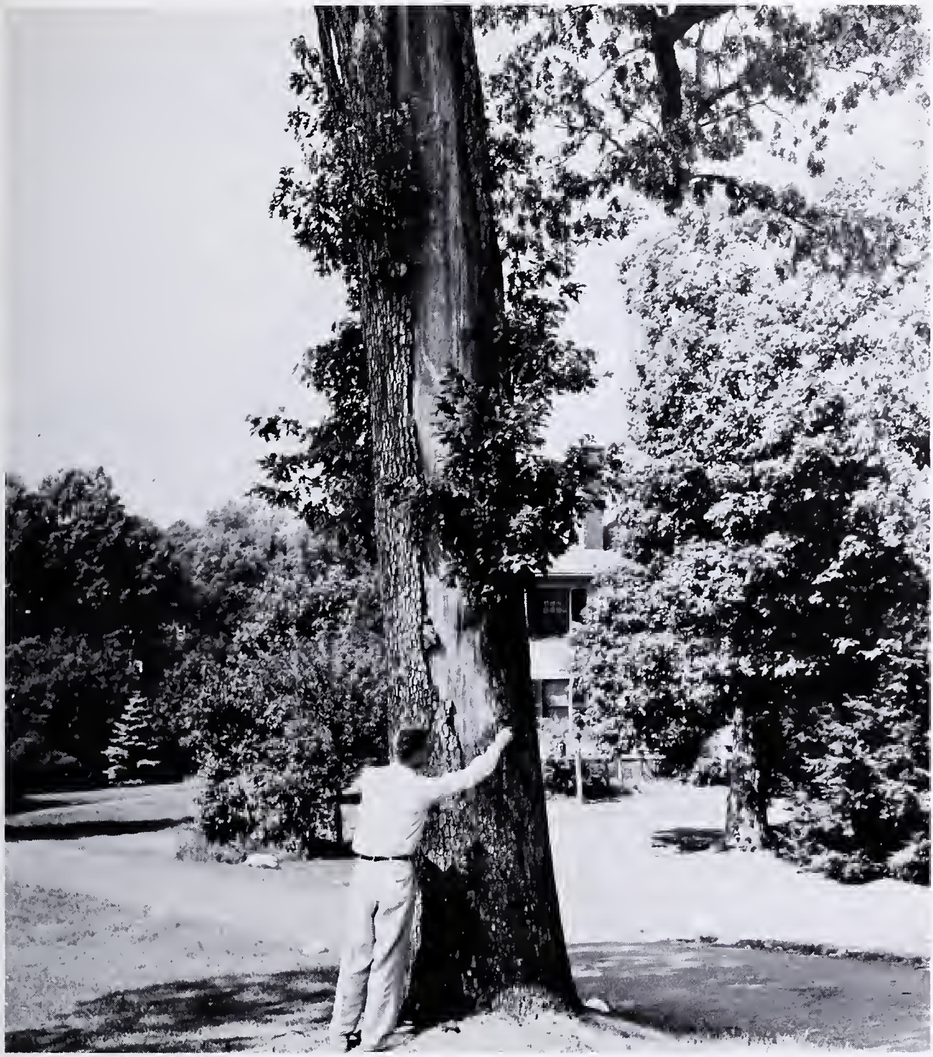
Lightning Injury. *Symptoms:* A long furrow in the trunk, if the tree was wet when hit. If dry, the tree may die, electricity moving through the cambium. Some trees, among them firs, explode when the current moves through the trunk center, converting moisture into steam. In wooded areas, tallest trees are most often hit. *Treatment:* If the tree is alive, treat the wound as in Mechanical Injuries. Protect valuable trees with flexible grounded metal cables, which later must be adjusted for growth. The cost of such lightning rods may be less than the cost to remove or replace the tree, apart from the loss of an established tree.

Hail Injury. See Mechanical Injuries

Flood Injury. *Symptoms:* Leaves are small and turn color early. Branches die back. Roots are discolored or dead. The entire tree may die at once, or gradually from decay. *Cause:* Oxygen deficiency, (although many trees can withstand brief spring flooding). Roots were smothered by protracted overflow of lakes, ponds, streams or rivers or by accumulation of water over a soil hardpan layer, or by a rise of the water table or by poor drainage. *Treatment:* Remove dead branches and treat wounds (see Mechanical Injuries). Control overflow of streams by dikes or by reforestation for better waterholding of the soil near the stream source. For hardpan, see Unsuitable Soil Texture. A permanent change of water table requires new landscaping and new trees.

Erosion Injury. *Symptoms:* Root tops are visible or gullies expose tree roots. Roots are wounded and may rot; leaves may show scorch. *Cause:* Particles of soil washed away when heavy rain falls onto compacted surface of bare earth or steep slopes. *Treatment:* Replace the earth and level the soil without adding deep fill. Plant grass or shrubs. A mulch such as wood chips also helps prevent hardening of the soil surface by rain impact.

Drought Injury. *Symptoms:* Leaf scorch. Leaves may fall in midsummer, twig growth is shorter, the new wood layer is thinner, and water-absorbing root tips may eventually die so that even after the rains resume the tree cannot pick up enough water. If drought is prolonged, it kills. Root rot and other diseases also kill many drought-injured trees a few years later. *Cause:* Rainfall was too little or too late. About half the normal amount is called a drought. *Treatment:* When the law permits, soak the ground under the tree (not the foliage) each week that rain is not adequate. Punch holes in the soil

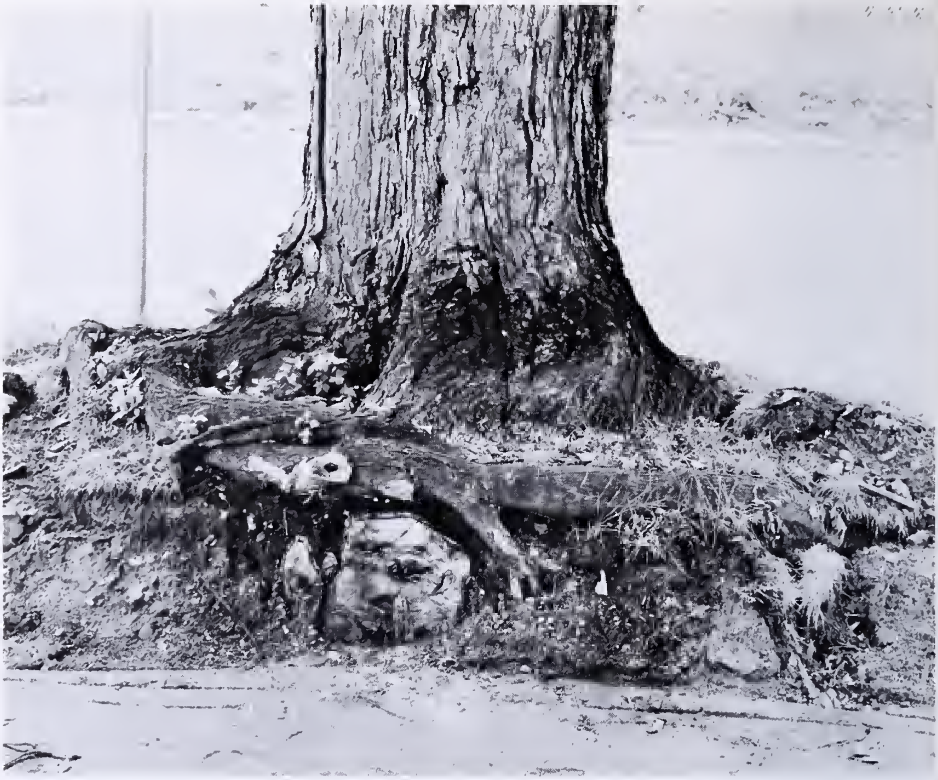


Although severely injured by lightning, this white oak is still alive and treatable by cleaning the wound and installing a lightning rod.

over the root system for penetration by the water. Most of the feeder roots are in the first foot below the surface and they often extend much farther sideways than the branches. The hose should lie on the ground and run at least one hour in each place. Special soaker boxes can be used.

Soil-Caused Problems

Unsuitable Soil Texture. *Symptoms:* Leaf scorch. *Cause:* Soil particles are too fine (clay) or too coarse (sand). When too fine, soil tends to be hardened by impact of rain, pedestrians or vehicles, until water and air no longer penetrate. Roots then suffer drought and suffocation. Sandy soil lets water sink too rapidly past the roots; these roots suffer drought but not suffocation. In contrast, clay hardpan or bedrock *beneath* average topsoil holds water near the surface, drowning the roots during a rainy period. In such a lo-



In all probability, this sugar maple will go into a severe and fatal decline. It has a girdling root, one of its main roots was cut to install a sidewalk and it is vulnerable to salt injury from the highway behind.

cation, the entire root system is so shallow that during a dry period it bakes to death. *Treatment:* Add organic matter to sandy or claylike soil. Loosen compacted surface layers. Place curb-stones to restrict parking. Add grass or a two-to-three-inch layer of mulch such as pine needles or woodchips. As mulch breaks down, it may alter nutrient levels or acidity, so make soil tests periodically. The soil under old lawns also can become compacted. Loosen it with a spading fork or a special roller that makes a multitude of tiny holes. Playground soil is compacted very rapidly; loosen it often. Add drainage where standing water accumulates. Breaking hardpan requires deep plowing involving special skills and equipment, and is not permanent.

Nutrient Deficiency or Toxicity. *Symptoms:* Small yellowish leaves and decreased growth depending upon kind of tree and which nutrient used. Chlorosis is discussed on page 15. Nutrient problems can be mistaken for many others. Learn which ones are most common in your whole region. *Cause:* Too little or too much nutrient in the soil. Necessary nutrients may be present but unavailable because the soil is overly acidic or alkaline. *Treatment:* Get details from your Extension Service on how to submit a soil sample. When you submit the sample, tell the kind of tree it is and report the symptoms of distress. Fertilize in spring or fall (not summer).

Soil Acidity or Alkalinity Injury. *Symptoms:* Yellowish foliage and reduced growth. In extreme cases, trees die. *Cause:* Soil is too acid or not acid enough (too alkaline), naturally or from chemical treatment. Essential nutrients may be unavailable even when present. *Treatment:* For most trees, adjust to slightly on the acid side of neutral (pH 6 to 7); however, some grow better with more acidity (pH 4 to 6). Have a soil analysis and request advice for that particular species of tree. To make soil more alkaline add ground limestone; to make it more acid add sulfur or aluminum sulfate. The amount to add depends upon soil type as well as how much change you want, and therefore depends on the soil analysis.

Chemical-caused Problems

Herbicide Injury. *Symptoms:* Local irregular dead areas anywhere on leaves, or death of entire leaves, may result from contact herbicides. A chemical such as 2, 4-D, with hormonal action, invades the whole plant, causing leaves and new shoots to become long, narrow, curled and twisted. Amino triazole, used to eradicate poison-ivy, turns leaves white. *Cause:* Weed killer droplets or vapors drifted from nearby spraying, or the tree was sprayed by mistake, or weed killer equipment was used by mistake. *Treatment:* Prevent even small traces of herbicides from touching your trees. Herbicides that are carried back into the tree may kill it or cause symptoms next year. Other herbicides kill only the spots they touch. If new leaves come out the same year, fertilize in late fall or early spring.

Salt Injury. *Symptoms:* Irregular yellow areas, or dead areas with yellow borders, between leaf veins and on margins. In severe cases, branches die back and trees may die. *Cause:* Ocean water or spray or salt run-off from roads or from storage piles, or so little rainfall that dissolved salts are left behind when soil water evaporates at the soil surface. Salt injury was visible in our test maples in Massachusetts when the leaf chloride content reached about one percent of dry weight (*i.e.*, about twenty times normal). Much of the salt put on roads in winter seems to run off with melted snow before the ground thaws enough for it to reach many tree roots, but winter salting of highways can injure many trees. *Treatment:* Promptly hose salt spray from foliage with fresh water. Copious amounts of water applied to salt-laden soil flushes out the excess salt so that if only a little salt is taken up by roots, most of it will accumulate in the leaves and be removed as the leaves fall in autumn. In a spot where road salt inevitably accumulates each year, plant an oak or other salt-resistant tree, or alter the drainage to carry the salt elsewhere. Choose tree cultivars from those being selected for salt resistance. Where highways must be salted, try to make new plantings on soil higher than the road surface, or thirty feet from the road edge if terrain is flat.

Gas Injury. *Symptoms:* Where severe, trees wilt, defoliate and die. In milder cases, branches die back, foliage is sparse, and leaves may be small and yellow-mottled. Bark may split and loosen. Wood may become brittle and bluish. Roots may become bluish-black. Grass and all other plants often die in a more-or-less circular area around the leak. Soil may become very hard and dry. A gas odor may be present when the soil is disturbed. *Cause:* Gas leaked into soil. Natural gas smothers and dries the roots by driving air and moisture out of the soil. Manufactured gas is moister but is directly toxic to living cells. Gas can be shown by a meter that analyzes the air in holes in the soil. Gas companies usually will test for suspected leaks. *Treatment:* Find and repair the leak promptly. Usually it is near the dying tree, but gas can travel far along small underground passages. After the repair, if the tree is in fair condition, water heavily, fertilize, prune dead branches and treat resulting wounds. In extreme cases, aerate the soil by injecting air or by removing and screening the soil before new trees are planted.

Air Pollution Injury. *Symptoms:* Discolored foliage suggests scorch, anthracnose, spray injury, herbicide injury, leaf spot disease, virus disease, insect infestation or nutrient deficiency or toxicity, depending upon the pollutant and the kind of tree. See page 11.

Insecticide or Fungicide Injury. *Symptoms:* Many small dead spots of variable size and shape, scattered over the foliage especially at margins and tips but absent where one leaf sheltered part of another. Bark, small branches and small trees may be killed. *Cause:* Spraying with the wrong chemical, wrong mixture, wrong concentration, wrong dose, or in the wrong weather (*e.g.*, too hot a day), or with the nozzle too near the foliage. Damage is more likely when leaves are expanding, but, unfortunately, that is when most sprays must be applied. Dormant oil sprays, usually applied in early spring, can kill when applied during the growing season. *Treatment:* Spray only when needed for a specific pest. Follow state recommendations and label precautions precisely. If possible, use professional arborists. They are trained to avoid spray injury.

Other Human-caused Problems

Pavement and Soil Compaction. *Symptoms:* Leaves scorch and tops of trees die back. Trees may die. *Cause:* New pavement, or compaction of the soil by feet or vehicles. Roots are deprived of oxygen and water. Carbon dioxide accumulates. Dead roots cannot supply tops of trees with water. *Treatment:* If injury is noticed early, remove pavement, loosen soil, and water weekly. Remove any dying trees. Final size of a new tree should be supportable by the water and air available to roots through the limited area of open soil surface.

Cut Roots. *Symptoms:* Leaves scorch; tops die back; roots rot; in severe cases trees may die. *Cause:* Roots were cut to lower grades, lay pipes, improve sidewalks, etc. *Treatment*: Prevention: Do not cut roots more than one inch in diameter. Make essential cuts with a sharp tool, cutting flush with larger root. Apply an antiseptic tree-wound dressing to cut surfaces before replacing the soil.

Fill and Too-Deep Planting Injury. *Symptoms:* Leaves scorch and tops die back, starting three to twenty years after fill was applied. Time of onset depends on depth and texture of added soil, and the age, vigor and species of tree. Trunk goes straight into the ground like a utility pole, rather than flaring outward at the soil line. *Cause:* A layer of earth was added to raise the grade or level the lawn around established trees, or a young tree was transplanted deeper than it originally grew. Roots then smothered. *Treatment:* If a small tree is affected, replant at proper depth. Earth should be removed by hand tools and wheelbarrows from over the root system of a larger tree because the weight of heavy machinery crushes rootlets. A "tree well' may postpone trouble, but the rest of the roots beyond the well eventually will smother. When soil depth has been adjusted, feed the tree and if the season is dry, give supplementary waterings. If fill removal would greatly injure roots, or if the new soil level is essential, plant new trees and cut those existing trees that die.

Crushed Roots: *Symptoms:* Leaves scorch, tops die back and trees may die. *Cause:* The velvet-like fuzz of feeding rootlets was sheared and crushed by the weight of heavy trucks, bull-dozers, etc. (even automobiles), over the soil where the roots grew. *Treatment:* Tree roots usually grow much farther from the trunk than branch tips. Enclose the area of the root system with fences or hedges. At the outset of home construction in wooded areas, fence off a forty-to-fifty-foot circle around the most valuable trees. After the injury: mulch, water and fertilize to encourage growth of new rootlets.

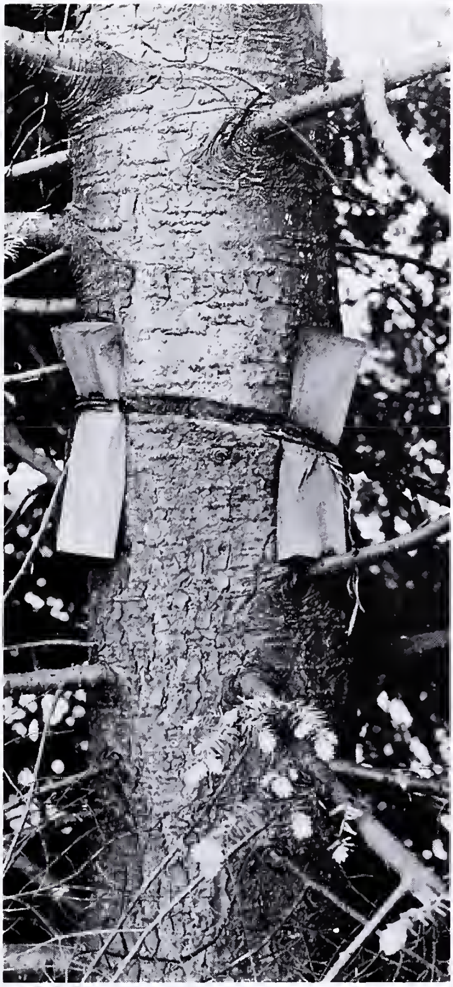
Fire. *Symptoms:* Often limited to one side of tree: death of lowest branches; dead area on trunk base, black, charred bark. Evergreens, containing pitch, may blaze like torches and then die. *Cause:* Fire, *e.g.* trash burners, burning houses or burning ground litter. *Treatment:* Prevention. Burn trash, if allowed, far from trees. Surround trees with areas of moist, green lawn to stop ground fires. After the fire, prune any branches that do not come into leaf. Treat trunk wounds (see Mechanical Injuries).

Mechanical Injuries. *Symptoms:* Bark is bruised, broken, cut, torn or removed. Exposed wood may rot. Trunk or branches constricted by tight bonds become swollen above (sometimes below) the bonds. Top of tree dies above point of girdling. *Cause:* Accidents, vandalism, chewing by animals, heavy snow or ice, hailstorms, human carelessness, forgetfulness, ignorance, amateur tree surgery. Lawn mowers frequently injure the trunks of small trees. *Treatment:* Prune away dead branches. Shape each wound to an ellipse with rounded tips, the long axis with the wood grain. If desired, dress exposed wood with an antiseptic (alcohol, shellac), then with an asphaltic paint containing a fungicide especially made for trees. Renew this dressing annually or as often as it cracks or peels. This treatment is controversial, but it keeps exposed wood intact and clean while the wound closes.

Clean and sterilize tools by wiping clean with alcohol (about 70%) or scalding with boiling water after finishing treatment of *each wound*. Oil tools before storage. To maintain high tree vigor and encourage better growth of healing callus over the wound, fertilize, water and mulch. Where healthy bark was merely knocked off, wounds will sometimes regenerate bark if covered *immediately*. Do not use wound paint here until it is certain which areas will die. Quickly replace the original bark, if intact, or cover debarked area with plastic to stop drying while a bark layer forms. Special grafting techniques should be attempted only by professional horticulturists and arborists. Remove bonds that might constrict normal growth. Teach children early that trees are living organisms, easily hurt by blows. Encourage them to respect and love trees.

Competition Problems

Girdling Roots. *Symptoms:* Leaf scorch, retarded growth and, a few years later, dieback of branches. Visible constriction in trunk or buttress roots by other roots, above or below ground, results in a bulge just above the girdle and no normal outward flare at the tree base. Girdling of most of the trunk circumference can be fatal. *Cause:* Roots grew across or around others, or around the trunk. As the tree enlarged, the constriction tightened. This may result from planting in too small a hole, but sometimes occurs on wild trees, too. Inspect container-grown nursery stock before planting. *Treatment:* Cut off girdling roots carefully with mallet and chisel. Prune dead branches. Prepare a hole of proper size when planting and make sure container-grown trees are not pot-bound. Spread roots out when planting.


Neglected and embedded guy wire girdling a hemlock trunk.

Shading-out. *Symptoms:* Low twigs, near the trunk and far from sunlight, die and fall off, littering the lawn. Branches die on the side where two trees' foliage is merged. *Cause:* Self-pruning, a normal reaction to loss of sunlight. *Treatment:* Space specimen trees far enough apart for light to reach all sides when trees are full-sized. When two trees nearly touch, remove the less desirable of the two. If one of a pair of closely adjoining trees must be removed, the remaining, deformed tree may never recover a normal shape. ☘

Good timing is of the essence . . .

THE DISEASE CYCLE

J. L. Peterson

Many gardeners have observed the sudden appearance of leaf spots or some other disease on their plants during the summer. They usually obtain a suitable fungicide and quickly apply it in the correct proportions to the plants, but much to their dismay the disease persists. In some instances gardeners have noted the approximate date when leaf spots first appeared. The following year, making sure they applied the fungicide at the time the disease was expected to appear, they again experienced poor disease control on their plants. If they used the correct fungicide, what then was the problem?

In situations such as this, a knowledge of the disease cycle as well as the life cycle of the fungus can be important. The disease cycle is the chain of events in disease development. When a pathogen such as a fungus is involved, it becomes part of the disease cycle. However, the fungus may be involved with the diseased plant only during *part* of its life cycle. The fungus may spend the balance of its life cycle on dead organic matter such as fallen leaves, an alternate host plant of another species or even in association with an insect.

The disease cycle as well as the fungus may be influenced by different environmental factors. Fungi may fail to sporulate (fruit) without proper temperature levels and sufficient moisture. The spores, which are the infection agents, may also fail to spread to a host plant without sufficient wind or splashing rain to carry them. The expression of disease symptoms may not be observed, even though infection has occurred, without a suitable temperature or moisture level. To bring about good disease control with the use of fungicides, one should have a knowledge of what the fungus pathogen is doing at a given time of year. If gardeners have a knowledge of the disease cycle and even the life cycle of the pathogen, they will know when fungicides should be applied for best disease control. The ideal time is when the fungus is most vulnerable to the chemical. This is usually just before or at infection time. Symptoms of many diseases do not become noticeable for some time after infection occurs.

Hawthorn Leaf Spot

Hawthorn leaf spot is an example where the knowledge of the disease cycle is important to fungicide application timing. In respect to the disease cycle the fungus pathogen overwinters as reproductive bodies on the bark or twigs of the hawthorn tree and on its fallen leaves. In the early spring, about bud break time and during wet weather, spores are discharged from the fungus reproductive bodies. The spores are carried by the wind and splashing rain to the young expanding leaves where they germinate and infection occurs. Small angular leaf spots are the first disease symptoms observed. The spots gradually increase in size and run together, and the infected leaves drop prematurely from the tree; trees may be completely defoliated by midsummer. Many people wait until the spots are quite noticeable before applying a fungicide. These applications may delay disease progression but do not control it. The main damage has generally been done before the time the disease was first observed.

Research at Rutgers University and other places shows that fungicides should be applied at leaf bud break and ten to twenty days later for good hawthorn leaf spot control. This is the time the fungus is initially active and is vulnerable to the fungicide. Since the best disease control is based on prevention, a knowledge of what the fungus is doing during the disease cycle will tell us when it is best to apply a fungicide treatment.

Firethorn Scab

A disease called firethorn scab can also serve as an example of what we are talking about. This disease resembles the apple scab disease (see p. 54), affecting both leaves and fruit. The fungus overwinters on fallen leaves, infected twigs and old berries on *Pyracantha* shrubs. In early spring during moist weather the spores germinate and the young expanding leaves are infected. The disease first appears as sooty leaf spots. The affected leaves soon turn yellow and drop prematurely; leaves that are formed later in the season often escape infection. As the young fruit sets and begins to expand, it is subject to infection. Scabby lesions ultimately appear on the ripening berries and are the most objectionable phase of the disease.

As with hawthorn leaf spot, proper fungicide timing is critical to the control of firethorn scab. If one waits until the spots appear, it is too late for adequate disease control. Sprays should be applied three to four times at bud break and at ten-day intervals thereafter.

Leaf Spot on Laurel

Timing is also important with Cercospora leaf spot on mountain-laurel (*Kalmia latifolia*). The leaf spots are circular-to-irregular and medium-to-dark brown. As they enlarge the centers become light brown and the margins dark brown. The spots are first observed on new leaves in mid-to-late summer, and even the most heavily infected leaves remain on the shrub until normal leaf drop the following spring. Fungicide sprays in midsummer or as spots become noticeable are ineffective. The fungus in this case overwinters on the old leaves still adhering to the bush the following spring. It becomes active and spores are spread to the young leaves as they are expanding during moist weather.

In an experiment at Rutgers, fungicide timing was very important for control of this disease. Table 1 shows the various fungicide timing sequences and the disease control results. Although the five-spray series beginning at bud-break and at two-week intervals controlled the disease very well, two sprays applied when leaves were first expanding and at flowering also gave good disease control. Again, the infection potential of the fungus was greatest between leaf bud break and the beginning of flowering. Sprays applied after flowering failed to control the disease.

Table 1. Cercospora leaf spot development on mountain laurel plants treated with fungicide sprays at various timing sequences.

Spray time[a]					Disease ratings[b]
1	2	3	4	5	
x	x	x	x	x	1.3
x		x		x	2.8
	x	x			2.0
		x	x		3.4
x	x				3.6
	x		x		4.1
x			x		4.6
			x	x	4.4
check					5.6

[a] Spray time: 1 = leaf bud break, 2 = new leaves emerging, 3 = flowering, 4 and 5 = two and four weeks after flowering, respectively.

[b] Disease rating: 1 = 0, 2 = trace, 3 = 1-2, 4 = 3-5, 5 = 6-8 and 6 = 9 + spots/leaf.

In all three cases discussed, control was excellent and flowering and fruiting was enhanced the following year when fungicides were applied at the correct time. Disease cycle studies to determine what the fungus is doing at a given time of the year show when the fungus is most active in initiating a disease. We also will know when the fungus is most vulnerable to fungicide action. Since most disease control methods are based on prevention of infection, this knowledge is important. Gardeners need not have a knowledge of the disease cycles, but they should be aware that control recommendations are based on cycle studies, and that to adequately control a disease they must apply fungicides at the specific times listed on the fungicide labels.

The rapid spread of . . .

DUTCH ELM DISEASE FROM MAINE TO CALIFORNIA

Richard J. Campana

Elms are dying from Dutch elm disease from coast to coast in the United States, and on the Pacific Coast stands will soon become more extensively diseased with additional spread. The disease is caused by a microscopic fungus, *Ceratocystis ulmi*, which is transmitted to healthy trees by the European and American bark beetles (but not by the common elm leaf beetles). It is lethal to most American elms affected, and to many individual trees of less susceptible elm species. Typically, diseased trees are characterized by conspicuous wilt of individual branch systems and by brown streaking of the wood beneath the bark.

Since its introduction from Europe to Ohio and several northeastern states in 1930, Dutch elm disease has spread in all directions. Its movement across the continent has occurred in three phases: the Northeastern, the Midwestern and the Far Western. During the first phase (the first twenty years), the disease was marked by spread to all of the northeastern states with limited spread into other regions; the second phase, from 1950 to 1970, saw the disease in all the midwestern and most of the southern states. In its latest phase there has been limited spread into the Mountain States and Pacific Coast. Thus, in less than fifty years after its introduction, Dutch elm disease occurs from coast to coast, with only a few diseasefree states remaining.

Among the forty-eight contiguous states, only Florida, Louisiana, New Mexico, Arizona, Utah and Nevada are apparently still free of Dutch elm disease. While the spread was not uniform, during the first twenty years it moved in all directions from two primary infection areas, although significant differences were noted.

Spread from the infection centers in Ohio and Indiana was primarily western,

The European elm bark beetle (left) and the larger native elm bark beetle are the insect vectors in the transmission of Dutch elm disease fungus.

Photos: Merck & Co., Inc.

In the past, high-density planting of elms made them extremely vulnerable to Dutch elm disease.

with merging of disease-affected areas toward the east but with significantly less spread either north or south. More rapid movement of the disease westward rather than toward the north or south is attributed to several factors. Susceptible populations were in greater abundance to the west and north than to the south, but the colder northern climate was less congenial to the European elm bark beetle (the primary vector) than the southern climate.

In the Northeast, from coastal or near coastal sites, spread was primarily northeastward, with somewhat less rapid spread directly east, north or west, and significantly less spread to the south. From its origin in Connecticut, New York, New Jersey, Maryland and Virginia, the disease spread three hundred miles northeast to Maine in nineteen years. During the same period it failed to move one hundred fifty miles southward across Virginia into North Carolina. Slow southward movement is attributed to various factors, such as limited numbers of elm populations in the Southeast, few insect vectors and intense heat.

After twenty years the western edge of the disease was in Illinois, from which it continued to move rapidly westward and, significantly less, to the north or south. As in the first twenty years, westward spread exceeded that either northward or southward. During this period the disease had crossed the Great Plains where native elms are few and spread into the Rocky Mountains where native elms do not occur at all. The last phase of disease spread (since 1970) is marked by intensification in the mountain states and movement across the last mountain barriers to the Pacific coast. Spread of the disease across the massive, natural barriers of the Great Plains and the Rocky Mountains must be viewed in a different context than spread east of the Mississippi River. The relative scarcity or absence of native elms in these last two vast regions is strongly indicative that long distant spread probably resulted from transportation of infected wood. The writer knows of one case where elm wood was moved with bark intact from Connecticut to California, and thus became the source for a new infection site. In any case, the disease is now known to occur around Portland, the San Francisco Bay area and Los Angeles County.

In the East, the impact of the disease in death and loss is greatest on the American elm, because of its native occurrence, large numbers, high susceptibility, and extensive distribution with massive urban populations from the Atlantic Ocean to the foothills of the eastern Rocky Mountains, although other elms and zelkova, an elm relative, are susceptible to a greater or lesser extent.

The American elm dominated and continues to dominate the Dutch elm disease picture east of the Rockies because of its distribution, numbers and urban plantings. However, as the disease spread into the high and dry Great Plains, the Siberian elm (*Ulmus pumila*) has become more important because of its relatively low susceptibility. As a key tree in shelterbelt areas, because of its fast growth and drought resistance, it is the elm of the future there. It is planted extensively in most of the mountain and far western states as well. In California I have seen extensive plantings in the High Sierras in eastern California, in the desert edge of the South, in the hot and arid Central Valley, and in the cooler more humid areas of the coast. However, it is in the high, dry plains and mountains where Siberian elm is most needed and most threatened by the disease.

In California, where there are no native elms and no compelling need for shelterbelts as in the Great Plains, the elm populations are diversified. No one species dominates the Dutch elm disease picture and naturally occurring infections have been confirmed in all major types of elms

Relative Susceptibility of Various Elms and Zelkova to Dutch Elm Disease

Tree	Source	Relative Susceptibility
Elm, American (*Ulmus americana*)	North American	Highest
Winged (*U. alata*)	North American	High
Slippery (*U. rubra*)	North American	High
September (*U. serotina*)	North American	High
Rock (*U. thomasii*)	North American	High
Wych (*U. glabra*)	European	High
Cedar (*U. crassifolia*)	North American	Medium
Smooth-leaved (*U. carpinifolia*)	European	Medium
Dutch (*U. x hollandica*)	European	Medium
English (*U. procera*)	European	Medium
Chinese (*U. parvifolia*)	Asiatic	Low
Siberian (*U. pumila*)	Asiatic	Low
Zelkova spp.	Asiatic	Low

present, including Chinese elm and zelkova. Fortunately, the American elm, the most susceptible species, is the least abundant; the moderately susceptible European elms also represent a relatively small percent of the population; and the highly resistant Chinese and Siberian elms (plus zelkova) make up the highest proportion of trees.

Because of high susceptibility, the American elms, as expected, are the worst affected. However, because they are not in great number, and because Asiatic elms are quite resistant, the major impact of the disease is likely to be heaviest on the European species. Another reason for this is the total "eradication" policy of the control program in California, requiring destruction of all infected trees, however slight the symptoms.

Factors Affecting Spread

Once established in a new region, Dutch elm disease has a life of its own. Given large numbers of susceptible trees, the presence of the causal fungus, and the presence of the bark beetle, the scene is complete for a seemingly endless cycle of infestation, infection, mortality, infestation, and so on. The principal and direct factors involved are the tree, the pathogen and the insect vector. Each factor is important in the disease cycle; the tree is killed while providing a massive substrate favoring proliferation of both pathogen and vector; the pathogen is the active causal agent of death; and the vector is the primary means for spread overland.

Two other factors, usually considered less important and more indirect, are the environment and man himself. The environment must be congenial for the development of the tree, the pathogen and the vector; although it is taken for granted that the disease cannot occur unless the environment is favorable, environmental extremes may affect probabilities for infection, disease development, or recovery. The factor of man *per se* is hardly ever considered, even though Dutch elm disease would not have occurred in North America without him. Not only did man import the pathogen, as well as the most significant insect vector, to North America, he also created the massive populations of urban monoculture of elms throughout the continent. In areas west of the Rocky Mountains he established them by planting almost all elms now present there.

The "less important" and "indirect" factors of the environment have had an unknown influence in spread of the disease in the East where the elms are at home on their own ground. In the new arid-to-semi-arid ecosystem of the West, environmental factors may have a far greater significance than in the East, but this, too, is as yet unknown. ⁂

DUTCH ELM DISEASE CONTROL BY THE HOMEOWNER

Control of Dutch elm disease by the homeowner may be possible with one or more well-established methods of proven value, but no method to prevent infection or induce recovery is always completely effective. Prevention of disease is more effective than inducing recovery; and prevention is possible through eradication, methoxychlor spray, and chemical injection with a liquid fungicide (Lignasan or Arbotect). Inducing recovery by chemical injection is possible where visible systoms of infection are less than five percent of the total crown, and infected branches are removed two or more days after infection. Eradication includes removal and disposal of diseased, dying or weakened elms or parts of elms before beetles can breed in them. Methoxychlor spray involves machine application of this insecticide over the entire branch system, if possible before leaves emerge in the spring. Chemical injection of a diseased tree has been more effective when injection was followed by deep pruning of a single, infected branch system as far back as the main trunk.

—R.J.C.

A story that has not ended . . .

THE AMERICAN CHESTNUT

Its Demise and Possible Recovery

Richard A. Jaynes

Chestnut means different things to different people. The Chinese chestnut is the most commonly available chestnut species in the U.S. today; nuts bought in the market are likely to be the European chestnut; and chestnut sprouts in the woods are remnants of a former stalwart, the American chestnut.

The American chestnut was the most important deciduous tree in the eastern United States at the turn of the century. The decay-resistant wood was used for railroad ties, utility poles, farm fences, mine timbers and general construction. The bark and wood were a prime source of tannin for the leather industry, and the nuts were an annual food source for wildlife and man. Hogs were regularly turned loose in Appalachia each fall to fatten on chestnut mast.

A bark disease, caused by the fungus *Endothia parasitica,* was introduced from the Orient in the late 1800's to New York City, where it was discovered and described in 1904. The chestnut blight fungus spread through the East at about twenty miles a year until, by 1950, virtually all the large American chestnuts from Maine to Alabama had been destroyed. Sprouts characteristically appear from the roots when large stems are killed. These develop into small trees before becoming reinfected, killed, and succeeded by more sprouts. The blight fungus does not invade the roots.

The disease attacks through wounds or fissures in the bark so that infection of a stem at any given time is a chance phenomenon. Rarely, stems may attain a diameter of eight to thirteen inches before becoming infected. Trees planted outside the natural range, as in the Midwest or West Coast, are generally not exposed to the disease and so may grow to maturity. Indeed, fruiting trees with two-to-three-foot diameter trunks are known in these areas. Even within the natural range there are still a few large trees. The value of these trees in developing a blight-resistant American chestnut is, as yet, unknown. To date they have not proven to have a high level of resistance or to possess the form and vigor characterized by the species in general.

Biological Control of the Chestnut Blight —The New Hope

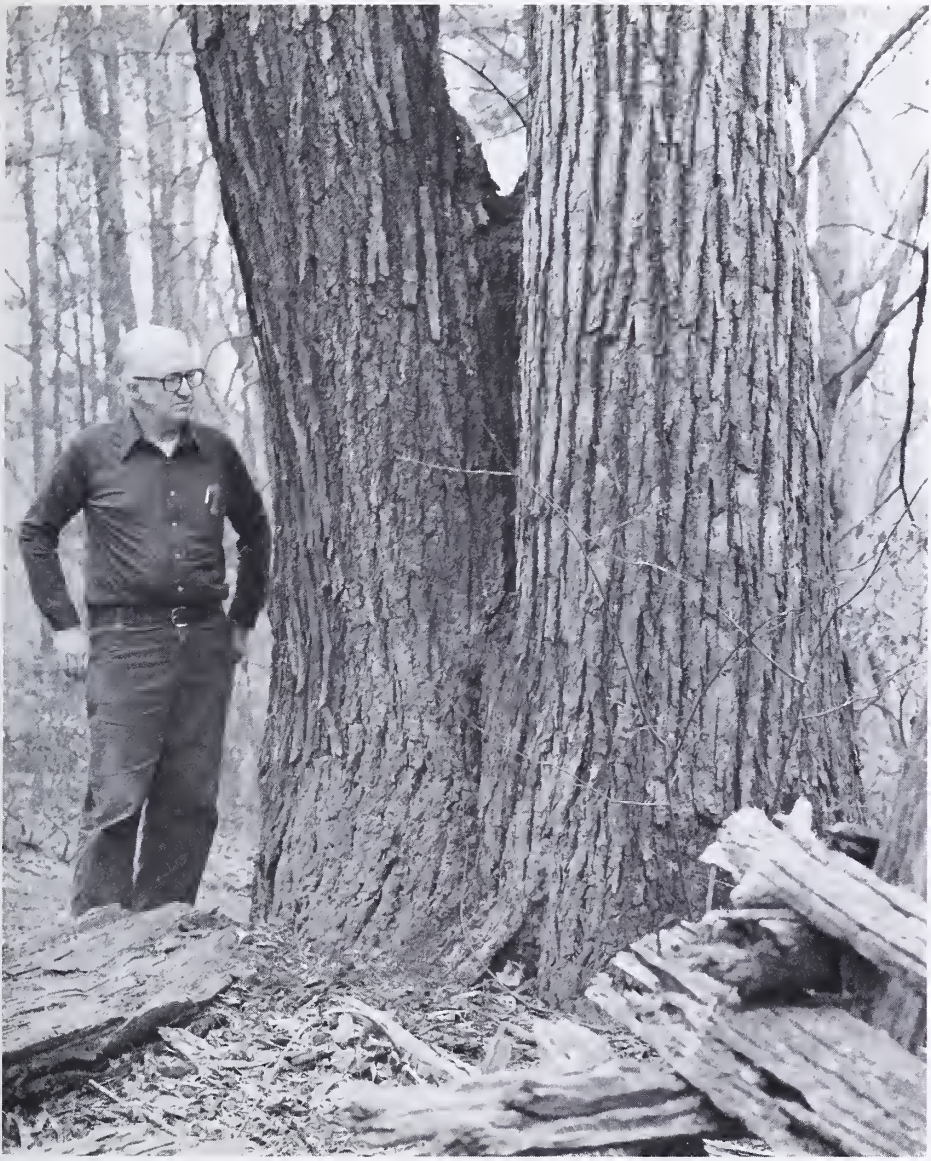
The chestnut blight fungus rampaged in Italy for several years after its introduction in 1938. Since 1950, however, natural control of the chestnut blight has occurred spontaneously, apparently the result of the presence and spread of virus-carrying strains of the chestnut blight fungus. In France the disease is being controlled through careful selection of, and inoculation with, these disease-curing strains.

The virus-carrying strains do not kill the tree but can and do convert the killing strains of the blight into non-killing strains. The beneficial strains have been imported into the U.S., and research with them is being pursued.

Significant differences between the European and American situation are apparent. The chestnut species are different, although both are attacked by the normal or killing strains of blight. Also, in Europe chestnut trees are usually grown in pure stands managed for nut or pole production, whereas the American chestnut grew in mixed hardwood stands and was unmanaged. Now, of course, it exists as an understory shrub.

Adapted from *Nut Tree Culture in North America* (1979), edited by Dr. Jaynes (Northern Nut Growers Association, Broken Arrow Rd., Hamden, CT 06518).

R. A. Jaynes



One of the few large surviving American chestnut trees in the eastern United States. This tree in Madison, Virginia, is blighted and much of the top is dead. Chestnut's durability is evident by the split rail fence in foreground.

Individual cankers on American chestnut have been controlled in tests with the disease-curing strains but the means of spreading the curative factor to other cankers is unknown. Insects could play a role in moving the virus-like particles from canker to canker. Means of spread, variations among the many blight strains and how the strains interact are under study. We hope that Robert Frost was truly prophetic when he wrote his poem in 1930 entitled, "Evil Tendencies Cancel." He asked, "Will the blight end the chestnut?" and replied, "[only] till another parasite shall come to end the blight." ❦

Meteorologists can predict some disorders . . .

WEATHER AND APPLE SCAB DISEASE

James A. Carr

Weather, insects and plant diseases are the great natural hazards of agriculture. The interrelationships among these three are so complex that it is frequently difficult to determine which is the primary factor, if indeed only one really is. There are three categories of plant diseases: parasitic, non-parasitic and viral. Parasitic diseases are caused by living organism such as fungi, bacteria, seed plants (like mistletoe) and nematodes. Nonparasitic ones include nutritional disorders and disorders caused by unsuitable soil, weather conditions or mechanical damage. Viral diseases are caused by a virus within the plant, which usually affects the entire plant.

Over the years, plant pathologists, meteorologists and entomologists have worked toward a better understanding of some of the factors which contribute to the onset of plant diseases. Apple scab, for example, has yielded to patient research and is now routinely controlled by orchard operators. Little attention, however, has been directed toward making such knowledge available to the home gardener. The program that follows was developed for commercial apple growing but applies equally well to flowering crabapple trees in the small garden.

Apple Scab

Apple scab is a fungus disease which causes spotty, misshapen and undersized fruit, excessive fruit and leaf drop, and scab lesions which provide a gateway for the entrance of rot organism. These in turn reduce both quality and yield.

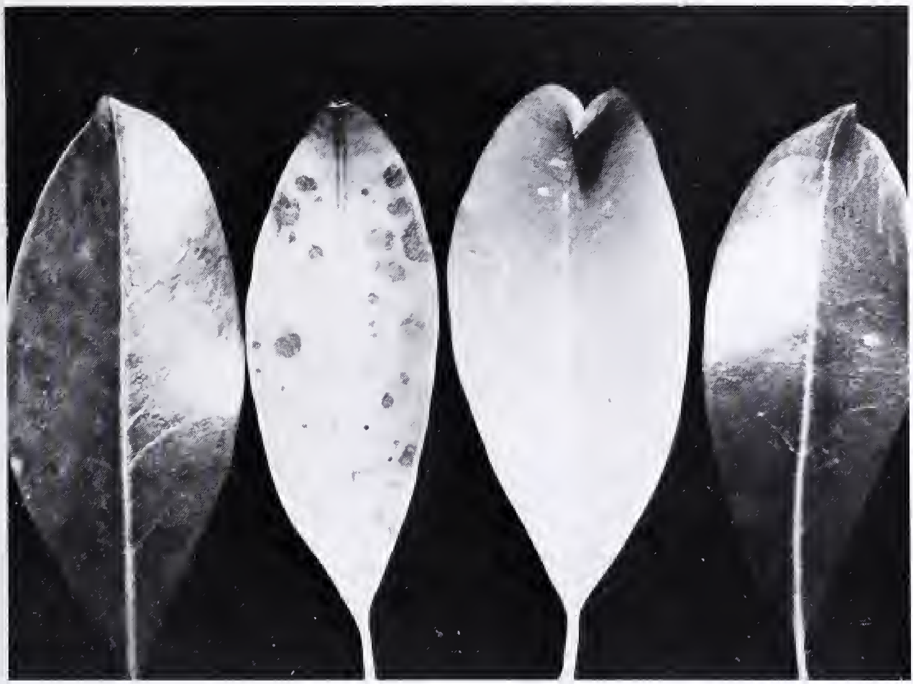
This parasitic fungus overwinters in an immature stage on old, fallen leaves which were infected during the previous growing season. During the cold season, the immature stage slowly develops and spreads, resulting in the growth of spore sacs within which the spores develop and mature. Spring rains and milder temperatures cause the sacs eventually to burst, releasing many spores into the air. Usually this takes place when the first buds are breaking. However, not all sacs mature at the same time; some reach maturity weeks after the initial spring release. But this is an idealized picture, because if there are frequent periods of rain in early spring many minor spore discharges may occur, resulting in a comparatively mild degree of infection. The total length of the spore discharge may spread over four to ten weeks.

The airborne spores may land on a new leaf or twig, but germination can only occur in the presence of water (rain, fog, drizzle) which keeps the spores wet for some period of time. The period of wetting needed for germination is related to temperature. At 45°F (7°C) the spores must remain wet for about twenty hours for germination to take place; while at 70°F (21°C) only only nine hours are needed. Germination and infection take place as a primary infection, producing spore-filled germ tubes which then provide a source for secondary infection each time a favorable wetting period occurs.

Estimating Leaf-scab Infection

The severity of primary infection is usually classified as *Light*, less than one percent infected leaves; *Moderate*, one to five percent infected leaves; and *Heavy*, more than five percent infected leaves. Table 1 (page 56) relates primary leaf-scab infection intensity to the duration of the wet period and the average temperature during that period.

The authors of the table add the follow-



L. M. Vasvary

Laurel leaf spot: left—unsprayed; right—treated.

ing remarks: "If the wet periods are intermittent, their duration should be added together until a period of about six hours of continuous drying occurs. This can be regarded as the end of the wetting period. If this period is sunny and drying is quick and thorough, it is safe to assume that six hours after the trees have dried, the danger period has passed. Any further rain after that will be taken as the starting point for the next danger period. If, however, the drying is slow and the atmosphere remains [humid], it is difficult to be certain when the trees are really dry, and the six-hour dry period mentioned above should be extended by a "safety" margin of a few hours—especially if the total time of wetting is nearly long enough to constitute an infection period. It is better to apply a spray unnecessarily than to risk losing a crop with black spot."

How to Use the Table

Suppose rain has fallen for fourteen hours while the temperature averaged 50°F (10°C), what is the expected intensity of infection? Refer to the table, locate 50°F (10°C) in the left hand temperature column, read across to the right and locate fourteen hours in the column labeled "Light" infection. If the average temperature remained the same but the rain ended after nineteen hours, the intensity would be classified as "Moderate," while a duration of twenty-nine hours at the same temperature would indicate "Heavy" infection.

For best results, the recommended spray(s) should be applied as soon as the wet period ends. (What constitutes a recommended spray varies from state to state, from country to country, and is beyond the scope of this article. Check with your Extension Service.) There are formulations available, however, which can give up to 38 hours of "back action." Such sprays will eliminate *all signs* of infection for wetting periods *up to 36 hours*. They operate by producing a neutralizing effect upon the growing infection so that, for example, in the case of a fifty-hour wetting period, the effective period of in-

TABLE 1. Approximate Hours of Wetting Required for Primary Leaf-Scab Infection

Average Temperature		Infection		
°F	°C	Light Hours	Moderate Hours	Heavy Hours
78		13	17	26
77	25	11	14	21
76		9.5	12	19
75-63	24-17	9	12	18
62		9	12	19
61	16	9	13	20
60		9.5	13	20
59	15	10	13	21
58		10	14	21
57	14	10	14	22
56		11	15	22
55	13	11	16	24
54	12	11.5	16	24
53		12	17	25
52	11	12	18	26
51		13	18	27
50	10	14	19	29
49		14.5	20	30
48	9	15	20	30
47		17	23	35
46	8	19	25	38
45	7	20	27	41
44		22	30	45
43	6	25	34	51
42		30	40	60
41	5.0	Over		
to	to	48		
33	0.6	Hrs.		

Source: Cornell Extension Bulletin No. 711 by W.D. Mills and A.A. LaPlante (1954).

fection is reduced to twelve hours.

Similar formulae have been developed which relate weather conditions and the advent or severity of diseases such as downy mildew of lima beans, late blight of tomato and potato, and others.

In the field of insect-transmitted diseases such as bacterial wilt of sweet corn, there are formulae which can predict the probable severity of that disease. When the formula has a low figure for average temperatures in December, January and February, we know there will be little wilt disease of corn that summer because there is little carry-over of the corn flea beetle that carries the disease. When temperatures are relatively high in the three-month winter period, then we can advise the grower to spray in early summer to decrease the insect-carried wilt disease.

All such information which can be developed to tie in anticipated disease or insect problems with weather conditions, and thus predictions for need for pesticides, helps not only the economics of the pest control program but, more importantly, may reduce the amount of pesticides needed for production of healthy ornamentals, fruit and vegetables.

Wise precautions for . . .

HOME GARDENERS—USE THOSE PESTICIDES SAFELY

J. E. Dewey and R. F. Pendleton

Pesticides are materials that control pests. Herbicides, fungicides, rodenticides, insecticides—all are pesticides. Even the safest pesticides can be hazardous. Nature itself controls most of our insect problems by means such as weather, predators and parasites. However, natural controls may not be entirely successful or may allow substantial damage before they take effect, so one must use some other method to control pests. Use of sanitation, cultivation, crop rotation, mechanical control (fly swatters), traps, baits, regulations and resistant varieties are all alternative methods, but usually the quickest and most reliable control is through the use of pesticides. Often they are the only practical method. But to avoid improper use one must answer several questions, then follow proper procedures.

Is A Pesticide Needed?

—Have you diagnosed the injury and identified the pest?

—Is the pest still present in a vulnerable stage?

—Have you decided that there are no feasible and effective alternative methods of control?

If the answers are "yes" then you can proceed to choose a pesticide.

Choosing The Best Pesticide

Usually more than one pesticide will be recommended for a particular problem. The best pesticide may not be the cheapest or most effective one. Check these items before buying. Is the pesticide available in small packages? Larger agricultural packages will probably have to be held over a period of several years, causing a storage and safety problem and risking deterioration of the pesticide.

Read the label. Information required on the label includes the degree of human hazard involved in handling the material—the "signal" words, directions for use and other hazards to be avoided.

Categories	Signal Word On Label
I. Highly Toxic	DANGER-POISON (skull and crossbones)
II. Moderately Toxic	WARNING
III. Slightly Toxic	CAUTION
IV. Relatively Nontoxic	CAUTION

Use those pesticides with the signal word CAUTION. Only occasionally do problems require a pesticide in the WARNING category. DANGER-POISON pesticides are restricted and can be purchased only by certified pesticide applicators.

Check the formulation. It must be compatible with your application equipment. Dusts or granules cannot be applied with a compressed air sprayer, nor should wettable powders be applied with a duster. Read the directions for application.

Be sure the pesticide is labeled for the use needed. Otherwise you may not control the pest, you may damage the crop, or residues may make it unfit to eat. Besides, you will be in violation of pesticide laws.

Some pesticides will control a wider range of insects, weeds or plant diseases than others. If your crop, for instance, has several different insect pests and you have a choice of pesticides, you will logically use the pesticide that controls the greater number of species. A word of caution: *do not apply* pesticides labeled for use on ornamentals to fruit or vegetable gardens unless they are also labeled for these uses. If the label recommends any

MULTIPURPOSE SPRAY MIXTURE

Amount of Pesticide per Gallon of Water

Pesticide	Ornamental Trees, Shrubs and Flowers	Vegetables	Fruit Trees
carbaryl (Sevin) 50% WP	2T	2T	
dicofol (Kelthane) 35% WP	1-1/2t		3T
malathion 25% WP	4T	4T	2T
zineb 65% WP	1T		
maneb 80% WP		2T	
methoxychlor 25% WP			3T
captan 50% WP			2T

use of protective equipment *do not buy* the pesticide. Look for one that is less toxic.

You may wish to use a multiple-purpose mixture of pesticides so that you can control insects, mites and plant diseases with mixture applied at regular intervals throughout the season. Some commercial mixtures are placed in packets that make one gallon of finished spray. You can purchase prepared mixtures, or make up your own mixtures from the chart below.

If you use the Multipurpose Spray Mixture chart, the amounts specified are to make one gallon of finished spray. (T = tablespoon, t = teaspoon). Use only wettable powder (WP) concentrates in preparing the mixtures. On roses substitute 4t folpet for zineb. If mildew becomes a problem add 2t of Karathane. To avoid excessive residues observe the following intervals between last application and harvest: leaf lettuce—14 days; head lettuce—7 days; green beans—4 days; green onions, peas, peppers—3 days; asparagus, cucumbers, tomatoes—1 day; apricots, nectarines, peaches—21 days; small fruits—14 days; other tree fruits—7 days.

Check the label for days from last application to harvest for any pesticides used on food crops.

Handle Safely

Always keep the pesticide in the original container; directions for mixing and use, safety precautions, first aid and medical procedures and other important directions will be always at hand.

Measure amounts accurately in a well ventilated area. If amounts are less than recommended, pest control may be poor; if they are more than recommended, plant injury or poisonous residues may be the result.

If you spill concentrate on yourself, wash it off immediately. Pesticides can enter the body in three ways: by swallowing (oral), by absorption through the skin (dermal), and by breathing vapor or dust (inhalation). Of these the dermal route is by far the most common cause of pesticide poisoning to applicators.

Mix only enough spray for the job. Then there will not be the problem of disposing of leftover spray mix.

Except for turf application, do not use herbicide sprayers to apply insecticides or fungicides.

Return the concentrate to a locked storage area before beginning to apply the mixture. Otherwise the untended concentrate can be a hazard to children or pets.

Check the weather before mixing and again before spraying. Be sure conditions are favorable.

Cover or move pet dishes, children's toys, sandboxes, etc., before applying pesticides.

Avoid letting pesticides drift away from the target area. Herbicides in particular can damage or kill sensitive plants. Pesticides must not be allowed to contaminate water unless they are labeled for use in water and purposely placed there.

The target should have thorough but not excessive coverage. Spray mixture that runs off the plant and onto the ground is wasted. The sprayer should be

BASIC PESTICIDES FOR THE HOME GARDENER

INSECTICIDES	GENERAL USE
acephate (Orthene)	aphids, caterpillars, leafminers, scales, mites, thrips, sawflies, some bugs
Bacillus thuringiensis (Dipel, Thuricide)	certain caterpillars, flea beetles
carbaryl (Sevin)	beetles, caterpillars, leafminers, plant bugs, some scales, turf insects
chlordane	subterranean termites
chlorpyrifos (Dursban)	ants, cockroaches, dog ticks, chinch bugs, cutworms, earwigs, mosquitoes, silverfish, spiders, tent caterpillars
diazinon	aphids, leafhoppers, leafminers, sawflies, scales, cutworms, chinch bugs
60-70 second superior oil	mites, mealybugs, scales
malathion	aphids, leafminers, mealybugs, whiteflies, scales, lace bugs
methoxychlor (Marlate)	beetles, caterpillars, mosquitoes
pyrethrum, synergized	flies, mosquitoes, springtails, whiteflies
rotenone	beetles, caterpillars, other chewing insects
MITICIDES	
dicofol (Kelthane)	mites
tetradifon (Tedion)	mites
FUNGICIDES	
benomyl (Benlate, Tersan 1991)	general purpose fungicide, systemic; mildew, molds and others
bisdithiocarbamates (mancozeb, maneb, zineb)	fungus diseases
captan	fungus diseases
chlorothalonil (Bravo, Daconil)	fungus diseases
Dyrene	turf fungus diseases
ferbam	fungus diseases
fixed copper (Bordeaux, Kocide, etc.)	fungus and bacterial diseases
folpet	fungus diseases
Karathane	powdery mildew
HERBICIDES	
2,4-D	most broadleaf lawn weeds
CDEC (Vegedex)	annual weeds in home vegetable garden

capable of enough pressure to atomize the spray mixture properly.

Avoid splashing yourself. Do not smoke, drink or chew gum while applying pesticides.

Clean up any spills immediately. Spills can be absorbed with vermiculite, catbox clay, dry dirt, or sawdust. Any home garden spills should be small, but, if ignored, could be a source of poisoning to pets or children. Dispose of the absorbent material as you would pesticide containers.

Wash outer clothing after each spray application. Wash it separately from the family laundry.

After spraying wait before harvesting food crops for the number of days specified on the label.

Disposal

Prepare only enough mixture for the intended use so you do not have mixed pesticide left over.

If you do have surplus mixed pesticide, apply it to an alternate target for which it is labeled.

As they are emptied, metal, glass or plastic containers should be rinsed three times and the rinsings poured into the sprayer. Where local ordinances allow, combustible containers should be burned. *Exception:* do not burn containers that have contained 2, 4-D-type herbicides.

Do not empty surplus mixture down the sink or toilet.

Storage

The locked storage should be in a dry, cool, ventilated area, preferably separate from the house.

Herbicides should be stored separately. Fumes given off by them may contaminate other pesticides. Also, chances of getting the wrong concentrate are much reduced by separate storage.

Do not store pesticides with food, medicine, fertilizers or cleaning supplies.

With proper observance of common sense rules and directions on the label, the pesticides available to home gardeners can be used safely and efficiently with minimal effect on the environment. ❧

SUGGESTIONS FOR FURTHER READING

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Pirone, P. P. *Diseases and Pests of Ornamental Plants.* 5th Edition, John Wiley and Sons, New York. 1978

________ *Tree Maintenance.* Oxford University Press, New York. 1978

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Westcott, Cynthia. *The Gardener's Bug Book.* 4th Edition. Doubleday, New York. 1973

________ *Plant Disease Handbook.* 3rd edition rev. by R. K. Horst, Van Nostrand Reinhold Co., New York. 1979

Also, contact your state university for list of available publications dealing with horticultural subjects. —S.H.D.

EQUIPMENT FOR APPLICATION OF PESTICIDES

Cynthia Westcott

Apparatus for the application of liquid garden sprays ranges from small aerosol cans to large power hydraulic sprayers and mist blowers.

Aerosol "Bomb"

The aerosol "bomb" is handy for indoor plants and for spot treatment of aphids or other pests on new shoots outdoors. It is not advised for general outdoor treatment. *Warning:* Injury may ensue if used too close to plants. Hold the can 12 to 18 inches away and operate it in short bursts. Make sure it is labeled for plants, not for household pests.

Hand Sprayer

Small hand sprayers of the atomizer type with continuous or intermittent action are likewise limited to house plants or a few specimens in the garden. They usually hold 1 quart.

Compressed Air Sprayer

The compressed air sprayer, of 1½- to 5-gallon capacity, will take care of most ornamentals in the garden if one is physically equal to pumping it up. It has to be shaken frequently. Most have tanks of galvanized steel, brass or copper but there is also a light-weight plastic model on the market. Many have a strap for carrying over the shoulder but some are mounted on wheels.

Knapsack Sprayer

The knapsack sprayer, carried on the back, is a bit heavy for a woman, but pumping is effortless, merely the lifting of a lever up and down during spraying. There is an efficient agitator.

Trombone Sprayer

The slide or trombone sprayer is liked by many gardeners because it is easily oper-

Drawings by Eva Melady

Trombone or slide sprayer, operated with both hands, draws material from a pail. Suitable for small trees.

Power sprayer for large gardens.

Compressed air sprayer has to be pumped and also frequently shaken.

Midget rotary duster with an extension tube should always be used with dust flowing upward.

→ Hose-end sprayer, easy to use where there is sufficient water pressure, draws chemicals from an attached jar and dispenses them in proper dilution.

ated and durable. Material is drawn from a pail or an attached container.

Wheelbarrow Sprayer

The wheelbarrow sprayer is a manually operated hydraulic sprayer mounted on a frame with one or two wheels. With a capacity of 12 or more gallons, it is fine for large gardens, but it takes two people to operate it efficiently.

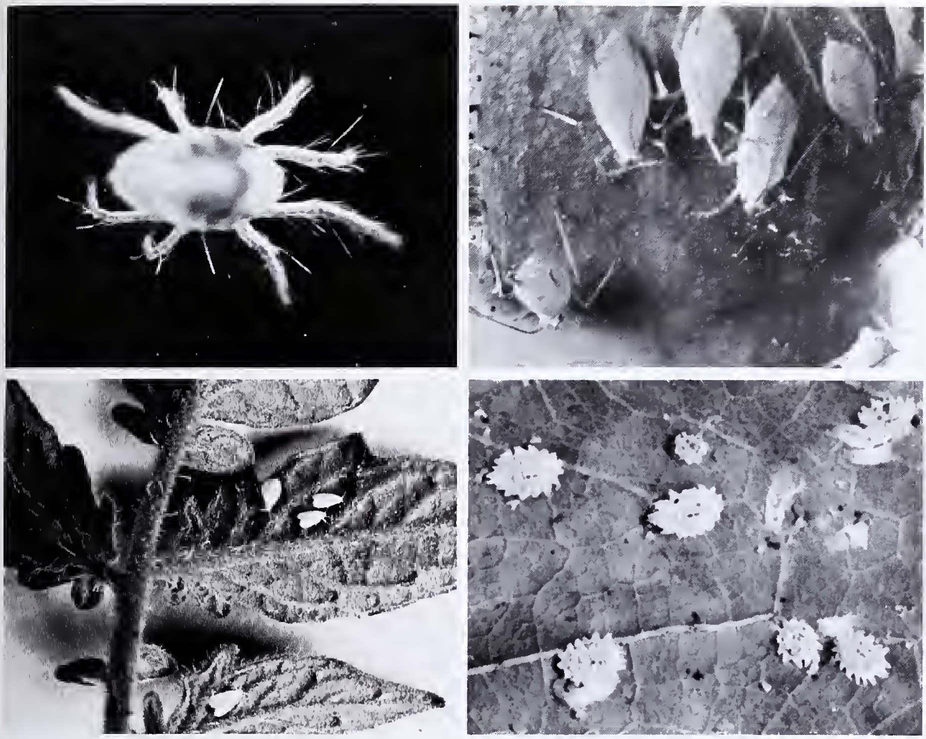
Hose-end Proportioner

The hose-end proportioner sprayer is easy to use where there is sufficient water pressure and a hose outlet near the garden. For shrubs use the type with extension tube and deflector so that the spray can be directed up through the foliage. Hose-end proportioners that spray out directly are mainly suitable for lawn treatment.

Various Dusters

Dusters range from a rubber bulb or cardboard carton to power equipment. Dust guns of 1-pint to 2-quart capacity are relatively inexpensive and satisfactory for small gardens. A light-weight midget rotary duster is excellent for any size garden and is well worth the price. Be sure to order an extension tube with the duster and be sure to use the machine with the dust flowing up. Enough dust drops down to take care of upper surfaces. A bellows duster, holding up to 8 pounds, allows quick coverage of a large number of plants, as does the crank-operated knapsack duster.

u.l., u.r.: McWorter; l.l.: BBC; l.r.: Buhle.



Banes of gardeners, clockwise from upper left: spider mite, aphids, mealybugs, whitefly on tomato leaflet.

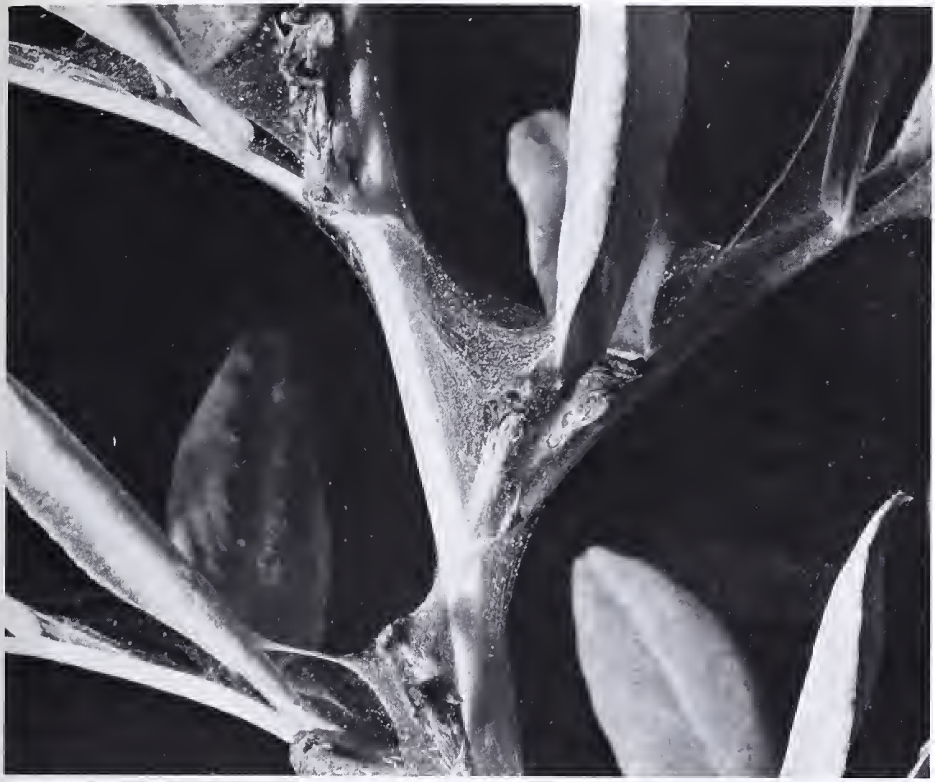
DISEASE AND INSECT CONTROL OF TREES, SHRUBS AND FLOWERS

Spencer H. Davis, Jr. and Louis M. Vasvary

Plant and Pests	Pest Identification	Control
Ageratum *(Ageratum)*		
Corn earworm	Brown worm boring in plant	Carbaryl plus dicofol in mid-August
Spider mite	Tiny reddish mites on lower surface of leaves and fine webbing	Dicofol or tetradifon when mites appear
Whitefly	Small white flying insects on underside of leaves	Diazinon or malathion; repeat 3 times at 5-day intervals
Ailanthus *(Ailanthus)*		
Air pollution	Minute gray stipple of upper surface only	Caused by ozone, no control
Cynthia moth	Large green caterpillars	Hand pick or carbaryl or malathion when first noticed

Verticillium wilt	Wilting and death of branch or tree with discoloration under bark	No control
Amaryllis *(Hippeastrum)*		
Bulb mite	Tiny white mites in rotting tissue	Discard soft bulbs
Leaf scorch	Red blotches on leaves, flowers and bulb scales	Zineb when first noticed
Narcissus bulb fly	Large yellow maggot in rotting bulbs	Dylox spray to base of plants in early May
Andromeda *(Pieris)*		
Lacebug	Upper leaf surface stippled gray; the lacebugs and brown droppings on lower surface	Malathion, diazinon or carbaryl in early June or as insects first appear; spray lower surface of leaves
Spider mite	Leaves turn yellow-to-brown with fine webbing	Dicofol or diazinon when damage is first noted
Arborvitae *(Thuja)*		
Bagworm	Cone-like bags, ½ inch long in June to 2 inch in late summer, with progressive defoliation	*Bacillus thuringiensis,* acephate diazinon, malathion, or carbaryl plus dicofol in mid-June and late June, or remove bags by hand
Leaf blight	Tips turn brown and tiny black pustules develop on dead tissue	Copper at budbreak; repeat 10 and 20 days later
Leafminer	Tips turn gray or white and tiny maggots are found inside the hollowed leaves	No insecticide labeled for this insect pest
Scale	Small, round whitish scales result in gradual death of tips	Malathion in mid-June and one week later
Ash *(Fraxinus)*		
Anthracnose	Irregular brown blotches on leaves	Mancozeb, maneb or zineb at budbreak and 10 and 20 days later
Borers	Larvae cause tunnels under the bark	Lindane in mid-May, mid-June and late August
Flower gall	Flower clusters on male trees develop into irregular galls	Dormant oil, follow with carbaryl just as first blossoms begin to form
Rust	Orange powdery clusters on leaves and petioles	Mancozeb, maneb or zineb at budbreak and 10 and 20 days later
Aster, China *(Callistephus)*		
Aster wilt	Plants wilt and die; stem at soil line is dry and stringy	Use resistant varieties
Blister beetle	Black striped beetle feeding on flowers	Carbaryl when first observed
Powdery mildew	White powdery coating on leaves	Benomyl at 2-week intervals
Leafhopper	Small, green quick-moving insects on underside of leaves	Carbaryl or malathion
Tarnished plant bug	Small, circular spots on leaves and withered shoots	Malathion when first noticed
Yellows	see article on MYCOPLASMA	

McWorter



Typical spider mite webs in leaf axils are a sure indication that mites are at work depleting plant vigor.

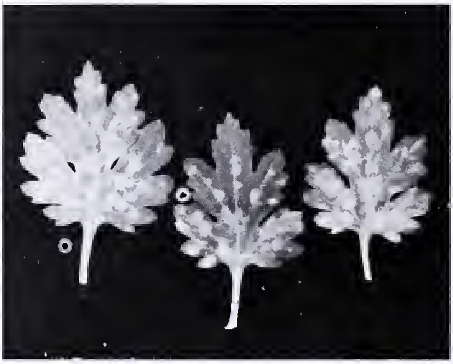
Azalea *(Rhododendron)*		
Bark scale	see under RHODODENDRON	
Black vine weevil	see under RHODODENDRON	
Bud and twig blight	Dead buds and twigs covered with black pin-point dots	Cut out diseased parts
Lacebug	see under RHODODENDRON	
Leaf gall	White or pink bladder-like growth of flower and leaf parts most severe when plants are kept wet	Remove when just a few are observed; we have not found sprays to be of value
Leaf rollers	Tiny yellow caterpillars roll the edges of leaves	Diazinon in early May, June and late August
Leaf spots	Various fungi cause brown, tan or gray more-or-less circular spots on leaves	Ferbam, mancozeb, maneb or zineb at budbreak; repeat 10 and 20 days later
Petal blight	see under RHODODENDRON	
Powdery mildew	White powdery coating on leaves	Benomyl at 2-week intervals starting in mid-summer
Spider mite	Leaves turn yellow-to-brown with fine webbing	Acephate, dicofol, tetradifon or dimethoate in early June or when first observed
Stem borer	see under RHODODENDRON	

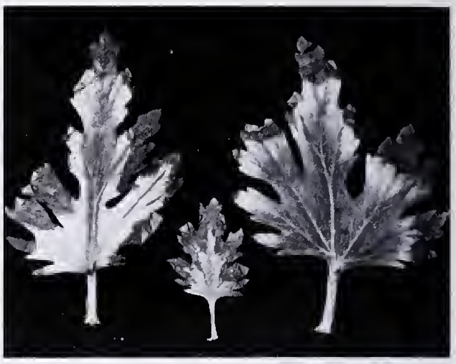
l. Roche; r. Herman Gantner

Frequently epidemic in wild cherry trees, the tent caterpillar also attacks ornamentals.

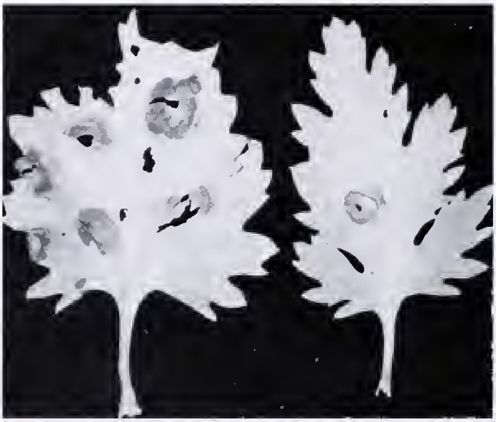
Barberry (*Berberis*)		
Barberry aphid	Yellow aphids form clusters on tender shoots	Malathion when first observed
Barberry scale	Brown nonmobile adults on woody parts cause weakened shoots	Dormant oil or use carbaryl in June
Verticillium wilt	Declining and dead shoots with blue-purple discoloration of inner wood	Remove bush and do not replant barberry
Beech (*Fagus*)		
Beech bark disease	A combination of tiny white scale insects and reddish pustules of a fungus coat the trunk and branches and cause decline and death of the tree	Malathion in September or lime-sulfur in early April
Beech mottle	Rows of brown spots between veins in the leaves result in a feathery appearance; caused by an air pollutant	No control
Woolly aphid	White cottony clusters of these insects on underside of leaves	Malathion when first observed
Birch (*Betula*)		
Aphid	Clusters of small green slow-moving insects on underside of leaves	Acephate, malathion, dimethoate, diazinon or Metasystox-R when first observed
Bronze birch borer	Larvae form tunnels under bark of main trunk	Lindane in late May and mid-June
Canker	Red outbreak of bark of main trunk	No control; keep tree in high vigor
Leaf miner	Brown blotches on leaves; break open and note yellow grub	Dimethoate, carbaryl, diazinon or Metasystox-R in mid-May and mid-June
Boxelder (*Acer*)		
Boxelder bug	Red and black beetles on trees and migrating to buildings	Carbaryl or diazinon on trees and around buildings

Boxwood *(Buxus)*		
Canker	Bark on dead branches covered with tiny black pustules	Copper at budbreak and 10 and 20 days later
Leaf miner	Blisters on leaves contain small yellow maggot	Methoxychlor, carbaryl, diazinon, dimethoate or Metasystox-R in mid-May
Psylla	Leaves form tight cups	Lindane in mid-May and 2 weeks later
Spider mite	Leaves turn gray-brown with minute webbing	Dicofol, dimethoate, diazinon or malathion when mites appear
Calendula *(Calendula)*		
Aphid	Black or green slow-moving insects on underside of leaves	Malathion, Metasystox-R or rotenone when first observed
Yellows	see article on MYCOPLASMA	
Canna *(Canna)*		
Bud rot	Flower buds turn brown and mushy	Cut off at least 6 inches below bud
Japanese beetle	A favorite plant	Carbaryl or methoxychlor
Catalpa *(Catalpa)*		
Leaf spot	Many small circular brown spots	Copper at budbreak and 10 and 20 days later
Powdery mildew	White powdery spots on leaves	Benomyl when spots first appear; repeat 20 days later
Sphinx caterpillar	Occasional pest, locally common	Acephate or carbaryl
Cherry, Flowering *(Prunus)*		
Black knot	Hard black outgrowths on twigs	Mancozeb, maneb or zineb when buds break, at pink bud, full bloom and 3 weeks later
Fall webworm	Cobweb tents at end of branches	Malathion, carbaryl or *Bacillus thuringiensis*
Leaf spot	Brown circular spots on leaves	Captan or dodine at petal-fall and 3 more times at 10-day intervals
Scale	Gray-white nonmoving adult scales on bark	Dormant oil, carbaryl or diazinon early and mid-June, late July
Tent caterpillar	Cobweb tents in larger crotches	Carbaryl, *Bacillus thuringiensis* or methoxychlor in early May
Chrysanthemum *(Chrysanthemum)*		
Aphid	Brown slow-moving insects on buds	Malathion or diazinon as needed
Flower blight	Petals or entire flowers turn brown prematurely	Benomyl weekly during flowering
Lacebug	White stipple of upper leaf surface and insects on lower surface	Malathion when first observed
Leaf nematode	Black "V" shaped areas between main veins	Remove infested plants and plant material
Leaf spot	Brown or black irregular spots on leaves	Mancozeb, maneb or zineb at 10-day intervals starting in June
Powdery mildew	White powdery coating on leaves	Benomyl when first observed; repeat at 2-week intervals
Plant bug	Small red-brown perfect circles in leaves; insects seldom seen	Methoxychlor as needed





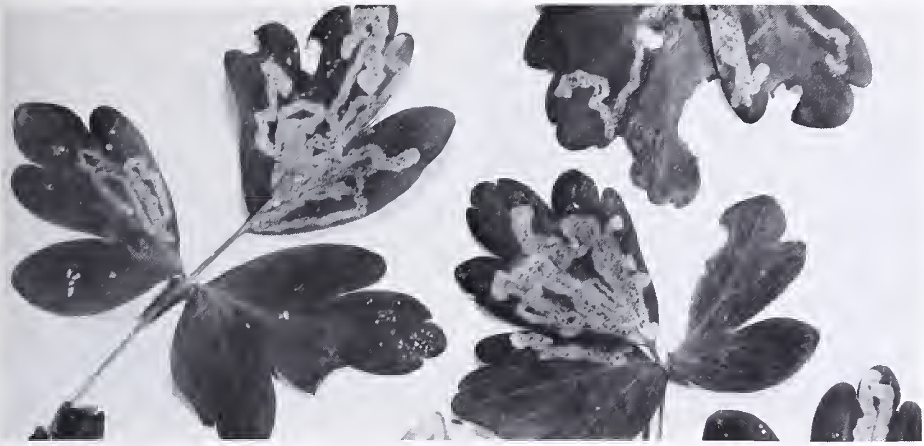
photos: S.H. Davis



Three of the fungi that attack chrysanthemums. Top left, powdery mildew; top right, verticillium wilt; left, leaf spot. All can be controlled if treated with the correct fungicide at the right times.

Rust	Reddish-brown "mildew" spots on leaves	Mancozeb, maneb or zineb at 10-day intervals when first observed
Verticillium wilt	Some varieties stunted and few flowers produced	Resistant varieties or soil treatment with Vapam before replanting
Clematis *(Clematis)*		
Blister beetle	Black-striped beetles feed on flowers	Carbaryl when first observed
Columbine *(Aquilegia)*		
Aphid	Green or brown slow-moving insects on lower surface of leaves	Malathion when first observed
Leaf miner	Gray snake-like pattern in leaves	Malathion when first observed
Sooty mold	Black sooty material on upper surface of leaves in droppings from aphids	Control aphids
Cotoneaster *(Cotoneaster)*		
Aphid	Green to brown slow-moving insects	Malathion when first observed
Fire blight	Sudden browning and death of branches	Prune out dead portions; use resistant varieties

Roche



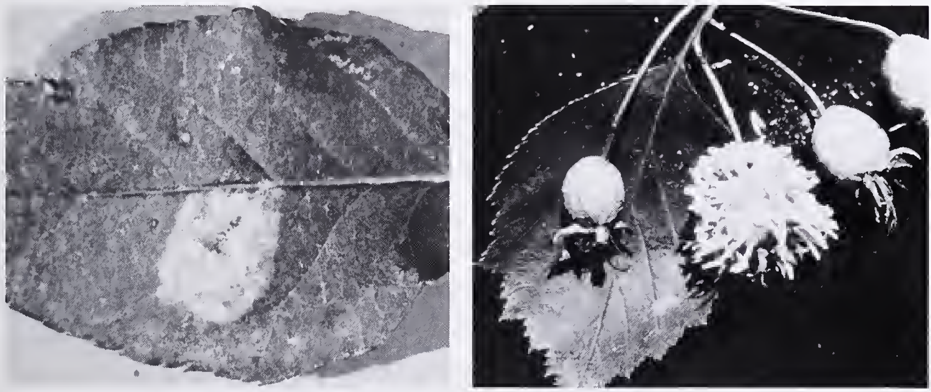
Characteristic leaf tunnels of leaf miner, here on columbine.

Lacebug	Gray stipple of upper leaf surface; brown spots and insects on lower surface	Acephate, carbaryl or malathion when observed
Scale	Gray nonmobile scale in adult stage on bark	Dormant oil early April, Carbaryl mid-June; repeat two times at 10 day intervals
Sooty mold	Black sooty material on upper surface in droppings of aphids and scales	Control aphids and scales

Crabapple *(Malus)*

Fire blight	Sudden browning and death of branches	Prune out dead portions; use resistant varieties
Powdery mildew	White powdery coating on leaves	Benomyl when first observed; repeat at 2-week intervals
Rust	Orange rust-cups on leaves, fruit or twigs	Mancozeb, maneb or zineb from pink stage until 2 weeks after petal fall at 10-day intervals

photos: S.H. Davis



Left, a rust fungus on a crabapple leaf; right, the bright orange "horns" of the cedar hawthorn rust on crabapple fruit.

Scab	Black diffused spots on leaves and tree defoliation	Captan, dodine or benomyl from budbreak until 2 weeks after petal fall at 10-day intervals; use resistant varieties
Tent caterpillars	Cobweb tents in crotches	Malathion in early May

Crape-myrtle *(Lagerstroemia)*

Aphid	Green to brown slow-moving insects	Malathion when first observed
Powdery mildew	White powdery coating on leaves	Benomyl when first observed; repeat at 2-week intervals
Sooty mold	Black sooty material on upper surface in droppings of aphids	Control aphids
Winter injury	Death of branches or entire plant	Most selections not hardy north of Delaware

Dahlia *(Dahlia)*

Aphid	Green slow-moving insects	Malathion when first observed
Flower blight	Premature browning of flowers	Benomyl at weekly intervals starting with flower coloring
Leafhopper	Small green quick-moving insects on underside of leaves	Malathion when first observed
Mosaic and Ring spot	Viruses causing irregular off-color streaks or rings in leaves and stunted plant	Remove plant and discard tubers
Powdery mildew	White powdery coating on leaves	Benomyl at 14-day intervals starting when first observed
Stalk borer	Death and breakage of stalks as result of insects inside stalks	Cut off and destroy infested stalks; spray carbaryl
Thrips	Small gray irregular snake-like etching of leaves and flower break-down	Malathion when flowers begin to open

Delphinium *(Delphinium)*

Aphid	Green slow-moving insects	Malathion when first observed
Crown rot	Plants wilt, roots blacken, red-to-brown pin-head "seeds" on diseased parts	Plant in another area next year
Cyclamen mite	Severely deformed leaves; mites too small to be seen with naked eye	Dicofol when injury first observed
Leafminer	Snake-like gray trails and blotches in leaves	Malathion when first observed
Powdery mildew	White powdery coating on leaves	Benomyl at 14-day intervals when first observed
Spider mite	Leaves turn yellow-to-brown with fine webbing	Dicofol when first observed

Dogwood *(Cornus)*

Calico scale	Gray-white wooly nonmoving scale on branches	Malathion in mid-June
Flower-leaf blight	Bracts ("flowers") fade and touch leaves; gray mold then causes leaf blight	Benomyl once, at end of flowering period
Flower-spot	Tan spots with purple border on bracts ("flowers")	Mancozeb, maneb or zineb as color appears and 10 days later

u.l.: L.M. Vasvary; u.r.: Roche; l.r.: S.H. Davis

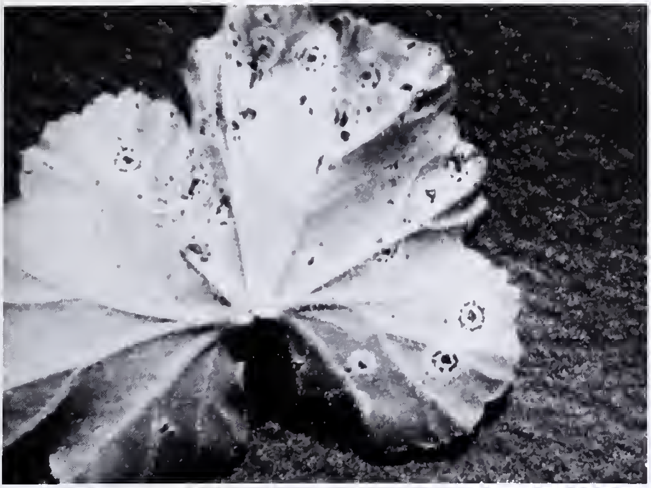
Above left, a thrips on a petal with a match head for comparison; above right, dogwood borer damage; right, dogwood leaf blight from fallen infected bracts.

Leafhopper	Irregular pattern of stippling of leaves	Carbaryl or malathion in May
Leaf spot	Brown spots with purple border on leaves	Mancozeb, maneb or zineb at budbreak and 10 and 20 days later
Trunk borer	Dead bark with borer tracks under bark on trunk and major branches	Lindane spray on trunk and main branches May 15 and June 15
Twig borer	Dead twigs with borer work at base of dead area	Prune out dead tips

Douglas fir *(Pseudotsuga)*

Cooley gall aphid	Crippled needles with yellow bands; aphids may or may not be noticed	Carbaryl or malathion in October or right before budbreak
Needle cast	Brown spotting of needles and needle drop	Copper at budbreak; repeat 10 and 20 days later

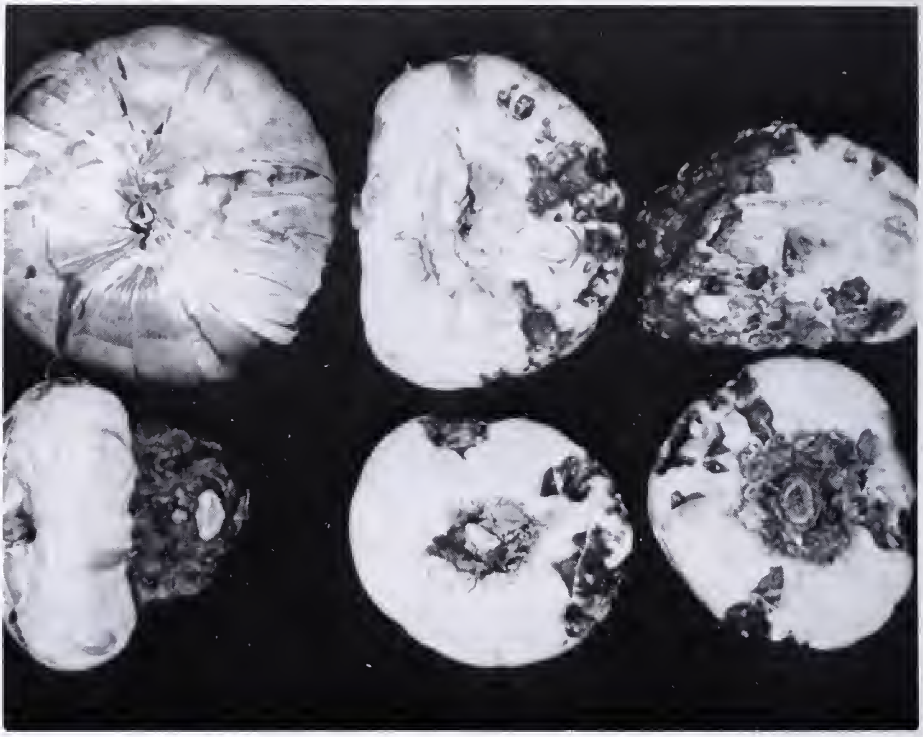
Elm *(Ulmus)*		
Aphid	Rolled leaves with clusters of insects inside rolls	Malathion when first observed
Cankerworm	Green inchworms and holes in leaves	Carbaryl, methoxychlor or *Bacillus thuringiensis* in early-to-mid May
Dutch elm disease	Wilting of leaves and death of tree; brown streaks in wood under bark	Methoxychlor as dormant spray; remove the dead tree (see p. 48)
Leaf beetle	Leaves skeletonized by yellow-black worm on underside; holes in leaves made by green-black adult beetle	Carbaryl or methoxychlor mid-May, late July
Leaf spot	Black tar-like spots on leaves	Mancozeb, maneb or zineb at budbreak 10 and 20 days later
Phloem necrosis	Yellowing of leaves and death of tree; honey-colored wood just under bark and wintergreen odor	No control; remove diseased tree
Sooty mold	Black sooty material on upper surface of leaves in droppings from aphids	Control aphids
Euonymus *(Euonymus)*		
Powdery mildew	White powdery coating on leaves	Benomyl at 14-day intervals when first observed
Scale	Gray-white nonmoving encrustation on stems and leaves	Dormant oil in April; acephate, malathion, diazinon or dimethoate mid-June and mid-August
Firethorn *(Pyracantha)*		
Aphid	Greenish slow-moving insects on underside of leaves	Malathion or Metasystox-R when first observed
Fireblight	Death of branches or much of the bush	Cut out diseased portions; use resistant varieties
Lacebug	Upper leaf surface stippled gray; the lacebugs and brown droppings on lower surface	Acephate, malathion or carbaryl
Scab	Black blotches on leaves, berries turn black	Benomyl, mancozeb, maneb or zineb at budbreak and 10 and 20 days later
Sooty mold	Black sooty material on upper surface of leaves in droppings from aphids	Control aphids
Forsythia *(Forsythia)*		
Plant bug	Small reddish-brown perfect circles in leaves; insects seldom seen	Methoxychlor as needed
Stem galls	Roundish galls with irregular surface on stems	Cut out as observed
Garden Pink *(Dianthus)*		
Aphid	Small green slow-moving insects	Malathion or Metasystox-R when first observed
Rust	Orange-brown pustules on leaves	Mancozeb, maneb or zineb at 10-day intervals



S.H. Davis

Geranium rust on underside of leaf.

Wilt	Plants wilt and die; base of stem dry and stringy	Remove and plant in another area next year; use resistant varieties
Gardenia *(Gardenia)*		
Canker	Brown sunken lesions on main stem	Ferbam as monthly spray; start cuttings in ¼ lb. ferbam in 100 lb. sand
Mealybug	White cottony clusters primarily in axils of stems	Malathion at 10-day intervals when first observed
Scale	Brown flattened nonmoving insects in adult stage	Malathion monthly when first observed
Spider mite	Tiny reddish mites and webbing of leaves	Malathion, or dicofol when first observed
Whitefly	Small white flying insects on underside of leaves	Malathion when first observed
Geranium *(Pelargonium)*		
Black leg	Blackening of base of main stem and death of plant	No chemical control; discard diseased plant
Gray mold	Spotting of leaves where old flower parts have dropped; death of adjacent stems	Benomyl at 14-day intervals during flowering
Mealybug	White cottony mass at leaf axils	Malathion at 10-day interval when first observed
Rust	Orange-brown pustules on lower surface of leaves	Mancozeb, maneb or zineb at 14-day intervals
Virus diseases	Various viruses cause mosaic, ring spot and leaf curl	Discard virus plants; do not take cuttings
Whitefly	Small white flying insects on underside of leaves	Malathion when first observed
Gladiolus *(Gladiolus)*		
Aphid	Green slow-moving insects on leaves and flower bracts	Diazinon or dimethoate when first observed



A corm rot of gladiolus caused by one of the numerous fungi and bacteria to which these flowers are susceptible.

Corm rots	Various fungi and bacteria cause pits or blackened areas on the corm or streaks in the corm with decline or death of tops	Discard deformed corms; do not save corms from diseased plants
Flower blight	Premature browning and collapse of flowers	Benomyl when first flower shows color
Leaf spot	Tan oval spots on leaves	Mancozeb, maneb or zineb at 10-day intervals
Thrips	Gray etched streaks on leaves and premature collapse of flower	Dimethoate, diazinon or carbaryl spray on plants; dust corms before storing with lindane or malathion

Hawthorn *(Crataegus)*

Aphids	Green or pink slow-moving insects on underside of leaves	Acephate, diazinon or malathion when first observed
Lacebug	Upper leaf surface stippled; the lacebugs and brown droppings on lower surface	Malathion or carbaryl when first observed
Leafblight	Hundreds of tiny spots on leaves and defoliation in early August	Benomyl, mancozeb, maneb or Daconil at bud-break and 10 and 20 days later

Rusts	Orange spots on leaves and horns on infected fruit	Mancozeb, maneb or zineb at budbreak and 10 and 20 days later
Woolly aphid	White cottony masses on bark	Diazinon or malathion when first observed

Hemlock *(Tsuga)*

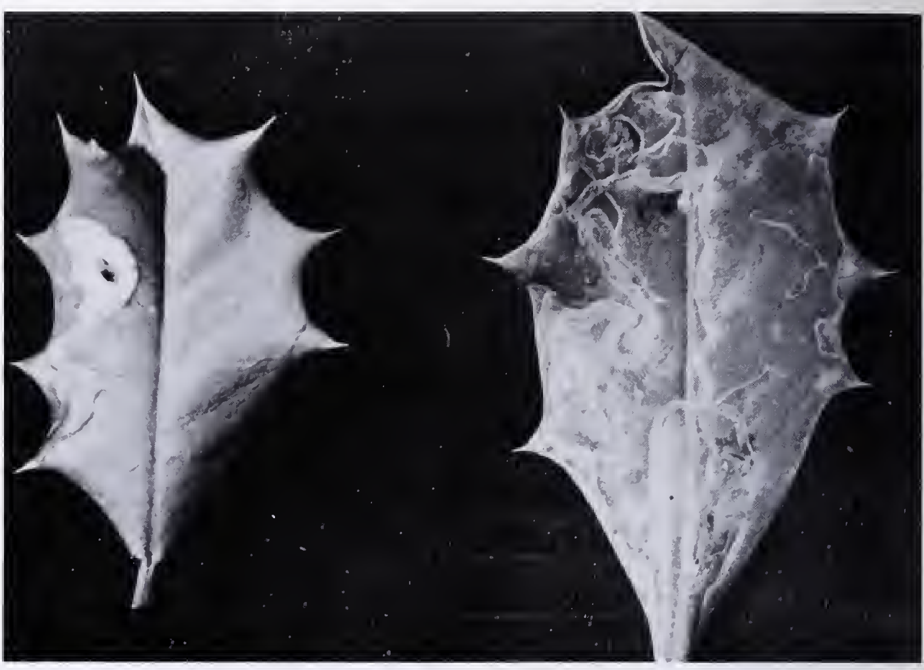
Fiorina scale	Twigs covered with waxy scale	Dormant oil plus ethion in April or dimethoate in early June and late August
Looper	Yellow caterpillars with black dots	Carbaryl in June
Needle scale	Gray scales on needles	Dormant oil plus ethion in April or dimethoate or malathion in late July
Rust	Orange pustules on needles	Mancozeb, maneb or zineb at budbreak and 10 and 20 days later
Spider mite	Needles turn gray with fine webbing	Dicofol, tetradifon or dimethoate in mid-May

Hickory *(Carya)*

Leaf spot	Irregular brown blotches on leaves	Mancozeb, maneb or zineb at budbreak and 10 and 20 days later
Stem gall	Green turning black galls on leaves, stems and twigs	Malathion in late April

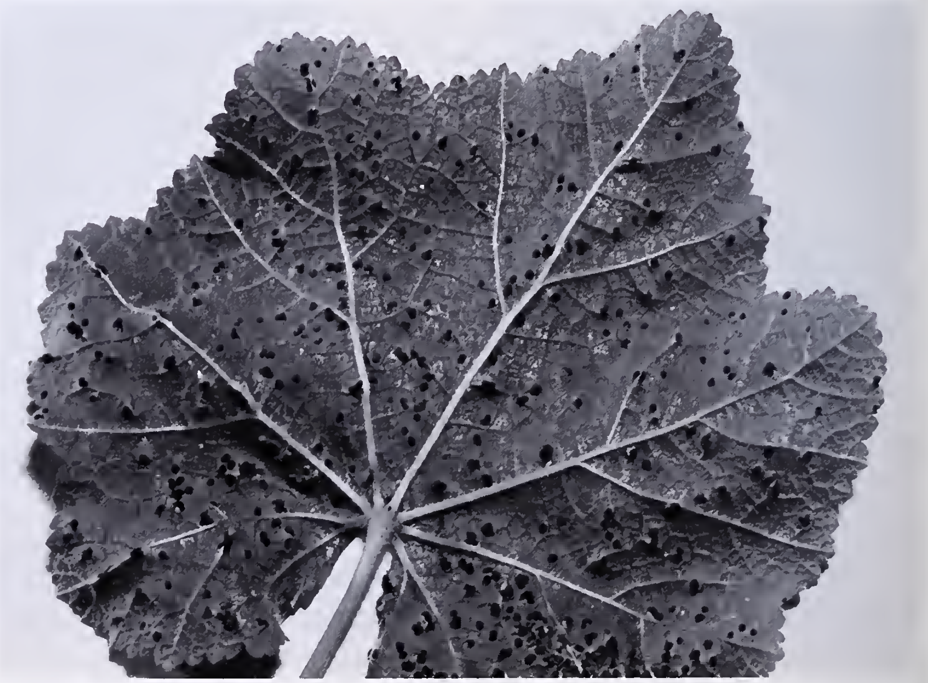
Anita Sabarese

Woolly aphid, an exotic-looking relative of common aphids, is controlled in the same manner.

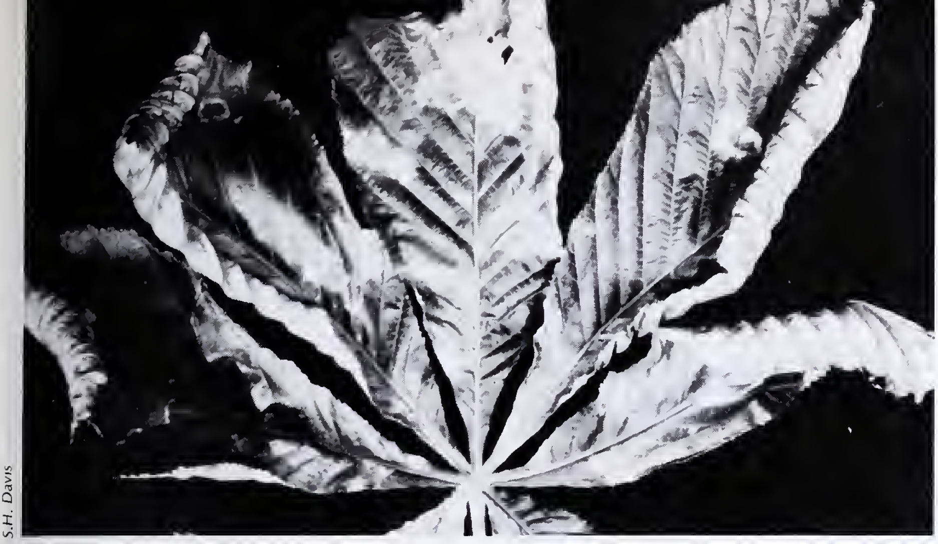


L.M. Vasvary

Above left, holly leaf miner; right, native holly leaf miner; below, hollyhock rust on the underside of leaf.

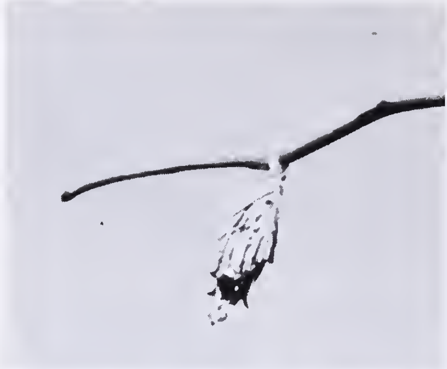


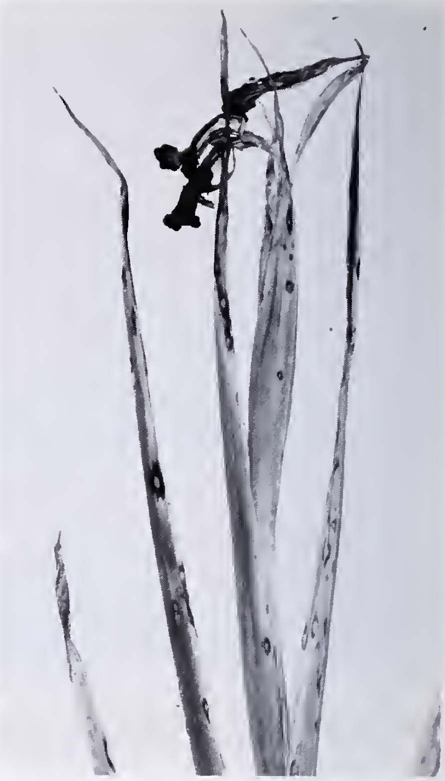
Roche

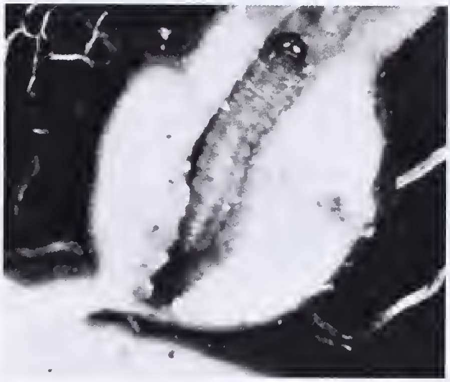

S.H. Davis

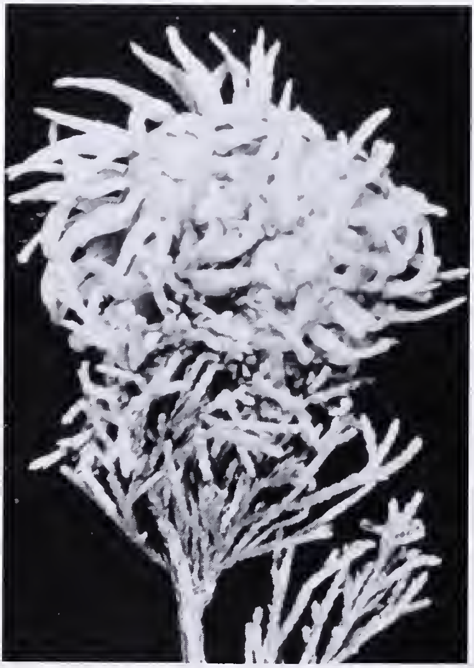
Horsechestnut leaf blotch with accompanying chlorosis and leaf curl.

Holly *(Ilex)*		
Berry midge	Berries turn black prematurely	Diazinon in late May
Leaf miner	Snake-like mines or blotches in leaves; tiny black flies emerge in late May	Diazinon in Mid-May, Metasystox-R in early June
Red mite	Stippling of leaves caused by minute red mite	Dormant oil 2% in late March or dicofol, diazinon or Metasystox-R when mites observed
Tar spot	Small, black tar-like spots on leaf surface	Ferbam at budbreak and 10 and 20 days later
Hollyhock *(Althaea)*		
Rust	Orange pustules turning gray on underside of leaves	Mancozeb, maneb or zineb, repeat at 10-day intervals
Spider mite	Stippled leaves with fine webbing	Malathion when first observed
Honeylocust *(Gleditsia)*		
Borer	White grub borers under bark of trunk and main branches	Lindane in late August on trunk and main branches
Mimosa webworm	Small brown caterpillars skeletonize leaves and form dense webbing	Acephate or carbaryl in mid-June, July and August
Pod gall midge	Leaflets become galled and defoliate	No insecticide is labeled for control of this insect pest
Honey suckle *(Lonicera)*		
Aphid	Green slow-moving insects cluster on new growth	Malathion or Metasystox-R when first observed
Sooty mold	Black sooty coating on upper surface of leaf and stems	Control aphids
Horsechestnut *(Aesculus)*		
Leaf blotch	Large, brown more-or-less circular blotches on leaves	Mancozeb, maneb, zineb, benomyl or daconil at budbreak and 10 days later





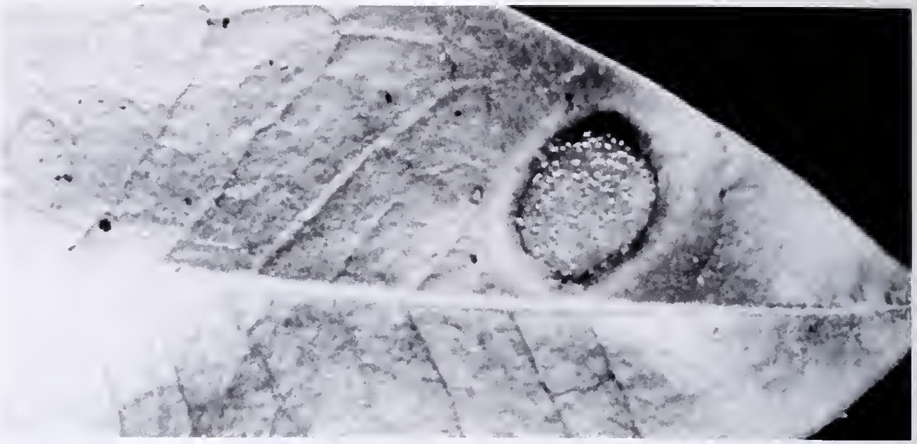




Top left, the typical sign of bagworm; top right, iris leaf spot; center left, iris borer in iris rhizome; left, cedar apple rust on juniper.

t.l., Anita Sabarese; t.r., Gould; c.l., L.M. Vasvary; b., S.H. Davis

Leaf scorch	Browning between veins and around edges caused by dry conditions	Water and fertilize
Hydrangea *(Hydrangea)*		
Flower blight	Flowers turn brown prematurely	Benomyl a few days after flowers open
Powdery mildew	White powdery coating on leaves and flower bracts	Benomyl when first observed
Iris *(Iris)*		
Borer	Small brown spots in leaves followed by large grubs in hollow rhizomes	Malathion, or carbaryl when leaves 4 to 6 inches long
Leaf spot	Oval brown spots with minute black specks on them	Mancozeb, maneb or zineb when first observed and 10 and 20 days later
Soft rot	Leaf tips turn brown and rhizome is mushy following borer infestation	Control borers
Ivy *(Hedera)*		
Edema	Brown corky spots on underside of leaves caused by excessive moisture	Less moisture and good air drainage
Leaf spot	Brown, circular spots with minute black specks on upper surface	Mancozeb, maneb or zineb at budbreak and 10 and 20 days later
Juniper *(Juniperus)*		
Bagworm	Brown cone-like bags grow larger as bushes are defoliated	Acephate, diazinon or malathion plus dicofol or *Bacillus thuringiensis* in mid-June and 2 weeks later
Rusts	Several kinds of rust cause brown galls or swellings with orange horns or pustules in early spring	Mancozeb, maneb, zineb or ferbam in early and late July and in August
Scale	Small, gray scales on twigs and needles	Malathion in mid-June and one week later
Spider mite	Foliage turns gray with fine webbing	Dormant oil in early April or dicofol when first observed
Tip blight	Tips 4-to-8-inches-long turn brown with minute black specks at base of brown area	Benomyl at budbreak and 10 and 20 days later
Webworm	Small brown caterpillars cause heavy webbing of clumps of shoots	Diazinon in early May and late July
Larch *(Larix)*		
Aphid	White woolly masses on needles	Malathion or Metasystox-R when first observed
Sawfly	Small, green "caterpillars" defoliate trees in early summer	Carbaryl when first observed
Larkspur	see DELPHINIUM	

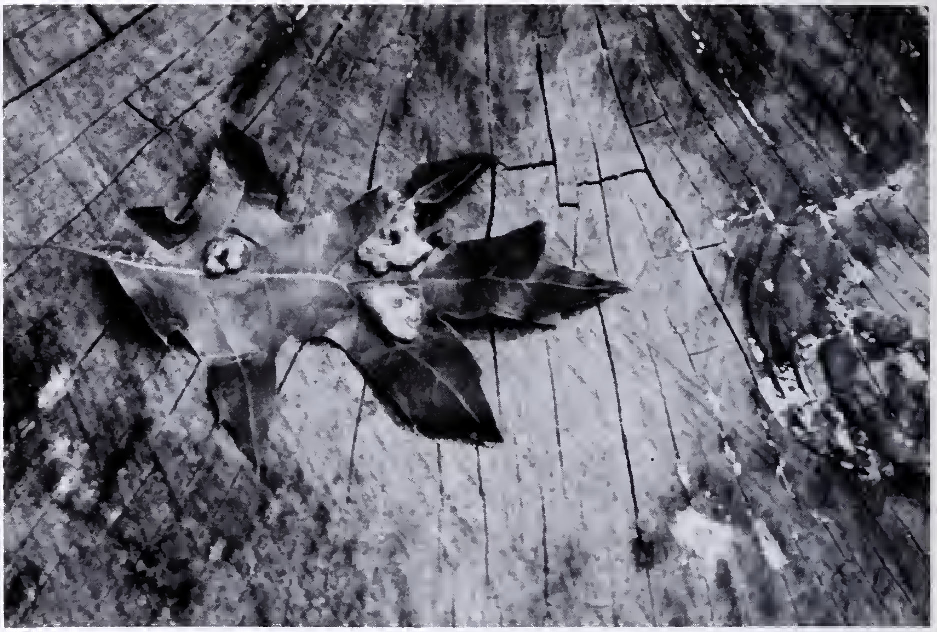


S.H. Davis

Laurel leaf spot, a fungus, is similar to those that attack azalea and rhododendron. All can be controlled with an appropriate fungicide.

Laurel *(Kalmia)*		
Lacebug	Gray stipple of leaves with lacy insects and brown spots on lower surface	Carbaryl or diazinon in June
Leaf spot	Brown circular spots with minute black specks on leaves	Benomyl at budbreak and 10 and 20 days later
Lilac *(Syringa)*		
Borer	Limbs die as a result of borers in larger branches	Lindane in early May and mid-June
Giant hornet	Large, yellow-banded wasps tear bark from larger branches	Carbaryl on bark during summer
Powdery mildew	White powdery coating on upper surface of leaves	Benomyl in July and August at 14-day intervals
Scale	Coating of small gray scales on bark	Dormant oil in early April and malathion in late May and early June
Lily *(Lilium)*		
Aphids	Green or black slow-moving insects cluster on leaves and flower	Malathion when first observed
Leaf and flower spot	Tan oval spots on leaves and flowers	Benomyl or zineb when first observed on leaves; repeat at 2 week intervals
Linden *(Tilia)*		
Aphid	Green, slow-moving insects on underside of leaves	Acephate or malathion when first observed
Cankerworm	Green inchworm chewing holes in leaves	Acephate, carbaryl, methoxychlor, or *Bacillus thuringiensis* in early May
Webworm	Small brown caterpillars cause heavy webbing of clumps of shoots	As for cankerworms, when webworms first appear
Sooty mold	Black sooty coating on upper surface of leaves and branches	Control aphids

Verticillium wilt	Dead branches with purple-brown discoloration of wood beneath bark	Remove branches (and, probably, eventually the entire tree)
Locust *(Robinia)*		
Leaf miner	Leaves become tan "envelopes" as result of yellow grub within the leaves	Diazinon in May and July
Magnolia *(Magnolia)*		
Scale	Large, brown leathery scales on twigs and branches	Dormant oil in April; acephate or carbaryl in mid-August and early September
Sooty mold	Black sooty coating on upper surface of leaves and branches	Control scale
Maple *(Acer)*		
Bladder gall mite	Small pink, yellow or green round galls on leaves	Carbaryl when buds swell in spring and 2 weeks later
Canker worm	Green inchworms and holes in leaves	Acephate, malathion, carbaryl, methoxychlor or *Bacillus thuringiensis* in mid-May
Leafhoppers	Small, light colored, fast moving insects causing stipple of leaves	Methoxychlor or carbaryl when leaves about ½ grown
Leaf spot	Circular brown spots on leaves	Mancozeb, maneb or zineb at budbreak and 10 and 20 days later
Norway maple aphid	Large, slow-moving insect on underside of leaves produce abundant "honeydew"	Malathion when first observed
Tar spot	Large, black tar-like spots on upper surface of leaves	Mancozeb, maneb or zineb just as buds swell in the spring
Verticillium wilt	Dead branches with bluish-green discoloration beneath bark	Remove branches (and, probably, eventually the entire tree)
Marigold *(Tagetes)*		
Flower blight	Premature fading of flowers with a gray mold	Benomyl at 2-week intervals during flowering
Spider mite	Fading of leaf color and fine webbing	Dicofol when first observed
Yellows	see article on MYCOPLASMA	
Mimosa *(Albizzia)*		
Mimosa webworm	Small brown caterpillars skeletonize leaves and form dense webbing	Acephate, carbaryl, diazinon in mid-June and 4 and 8 weeks later
Mountain-ash *(Sorbus)*		
Aphid	Green slow-moving insects on lower surface of leaves	Acephate or malathion when first observed
Borer	Grubs under bark of main trunk result in decline of tree	Lindane in mid-June and mid-August
Leaf blight	Tiny brown spots on leaves result in early defoliation	Benomyl, mancozeb or maneb at budbreak and 10 and 20 days later
Sawfly	Green larvae destroy leaves	Carbaryl when first observed

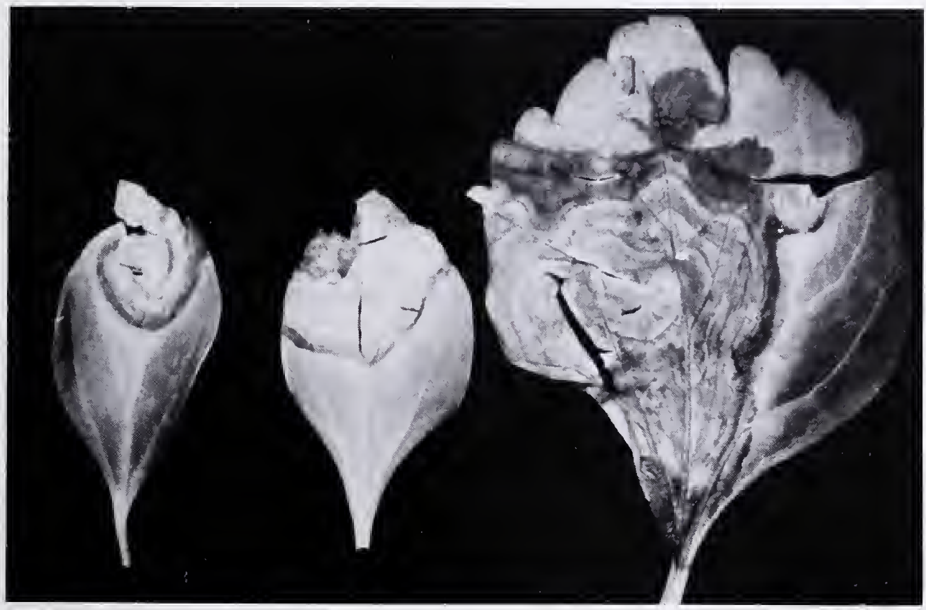


Anita Sabarese

One of the more-or-less typical galls, caused by insects, that are found on oaks.

Myrtle *(Vinca)*		
Canker	Large brown spots on leaves and black dead areas on stems	Benomyl when new spring growth appears and 10 and 20 days later
Oak *(Quercus)*		
Canker worm	Green inchworms chew holes in leaves	Acephate, carbaryl, methoxychlor or *Bacillus thuringiensis* early-to-mid-May
Gall insects	Many types of small-to-large, smooth or wooly bladders on leaf surface	No practical control
Lacebug	Stippled leaves with lacy insects and brown spots on lower leaf surface	Acephate, malathion or carbaryl when first observed
Leaf blister	Blistered or crinkled spots on leaves	Mancozeb, maneb or daconil at budbreak and 10 and 20 days later
Leaf miner	Brown spots where leaves are mined	Acephate or malathion when first leaves are ½-grown
Leaf roller	Small dark-headed worms roll and chew holes in leaves	Acephate or carbaryl or methoxychlor in early May
Leaf spot	Brown more-or-less circular spots with minute black specks	Mancozeb, maneb or zineb at budbreak and 10 and 20 days later
Scale	Many tiny pits on twigs and branches with minute scale in center of pits	Dormant oil in April; carbaryl in mid-June repeated 3 times at 10-day intervals

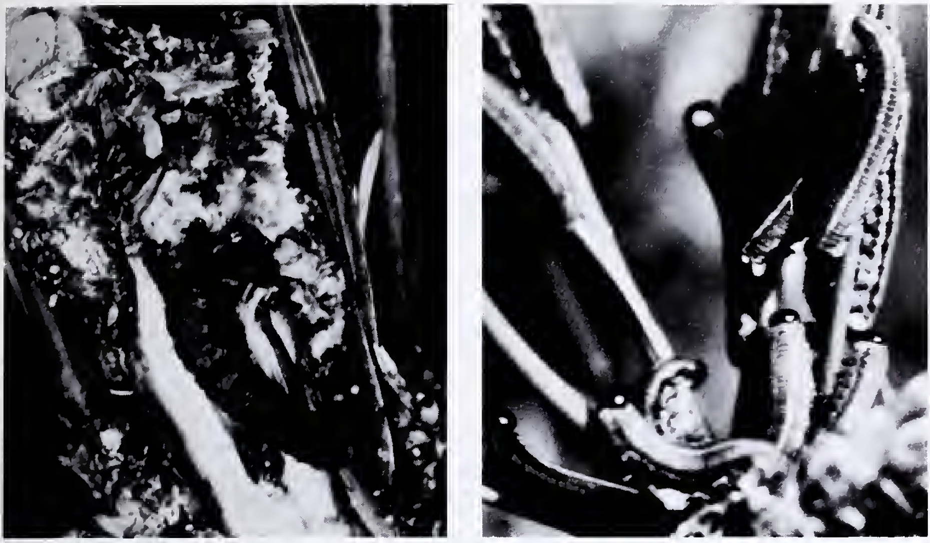
Sawfly	Small greenish slugs feed on lower leaf surface removing all but upper layer of cells of leaves; damage first appears in treetops	Carbaryl in June and August
Spider mites	Stippled and dusty leaves with fine webbing	Dicofol when first observed
Twig pruner	Small twigs with clean-cut ends drop to ground	Pick up in May and destroy
Webworm	Small brown caterpillars make clumpy webbing of shoots	Acephate or carbaryl or *Bacillus thuringiensis* when webs appear
Oleander *(Nerium)*		
Aphids	Black or green slow-moving insects cluster on new shoots	Malathion when first observed
Scale	Tan circular scales on twigs and branches	Malathion, repeated monthly
Sooty mold	Black sooty coating on upper surface of leaves and branches	Control aphids and scales
Pachysandra *(Pachysandra)*		
Canker	Brown circular spots on leaves and dead areas on stems covered with brown "sandpaper"	Mancozeb or maneb at budbreak and 10 and 20 days later
Scale	Gray-white nonmoving encrustation on stems and leaves	Dormant oil in April; carbaryl, malathion or diazinon mid-June and mid-August
Palms *(Various genera)*		
Scales	Many species of white, brown and purple, flat or rounded scales encrust stems and leaves of different palms	Summer oil or malathion when first observed; repeat at 2-month intervals



S.H. Davis

Pachysandra canker causing leaf spot.

Skeletonizer	Caterpillars feed on leaves and produce protective webbing	Carbaryl every 2 months
Pansy *(Viola)*		
Anthracnose	Tan roughly-circular spots on leaves	Mancozeb, maneb or zineb when first observed; repeat at 10-day intervals
Aphid	Green slow-moving insects in clusters	Malathion when first observed
Gray mold	Portions of, or entire clumps turn brown and are covered with a gray mold	Benomyl when plants are crowded
Spider mite	Stipple of leaves and fine webbing	Dicofol when first observed
Peony *(Paeonia)*		
Flower blight	Buds the size of a quarter turn brown and are covered with gray mold	Benomyl at 10-day intervals starting when buds are pea-sized
Aphid	Green slow-moving insects on leaves and buds	Malathion when first observed
Rose chafer	Tan, long-legged beetles on flowers	Methoxychlor in late May and June
Thrips	Not visible to the naked eye, thrips cause flowers to ball-up and petals turn brown at edges	Malathion when problem first observed
Ants	Do not cause damage	None
Phlox *(Phlox)*		
Powdery mildew	White powdery coating on leaves	Benomyl when first observed and at 10-day intervals
Spider mite	Leaves turn gray-brown with fine webbing	Dicofol when first observed
Pine *(Pinus)*		
Bark aphid	White, cottony clumps on trunk and main branches	Dormant oil, follow with malathion or diazinon in mid-May
Nantucket tip moth	Tips of branches die as result of small larvae under the bark	Acephate or dimethoate in mid-May and mid-to-late July
Pine shoot moth	Tips of branches die as a result of larvae in center of stem	Diazinon or dimethoate in mid-April and late June
Rusts	Orange pustules erupting through bark of trunk or banches indicates one of several rust diseases	No spray control; each rust disease has a specific "alternate host"; identify and eradicate alternate host
Sawfly	Clusters of naked larvae devour all needles on infested branch	Methoxychlor or carbaryl when first observed
Scale	Gray, elongate scales on needles	Dormant oil, then malathion end of May, during June and mid-August
Spittlebug	Frothy "spittle" cover the insects feeding on twigs	Lindane when first observed
Tip blight	Dead tips with tiny black pustules on needles, particularly on Austrian pine	Benomyl or copper as buds start to swell and 10 and 20 days later
White pine weevil	Sudden death of top shoot in tree with many white grubs just under the bark	Lindane to top leader in early-to-mid-April; remove and destroy dead top



photos: L.M. Vasvary

Left, European pine shoot moth caterpillar in pine; right, European sawflies on pine tip.

Planetree	see under SYCAMORE	
Primrose *(Primula)*		
Flower blight	Flowers fade prematurely with gray powdery covering	Benomyl at 14-day intervals during flowering
Spider mite	Leaves turn gray with fine webbing	Dicofol when first observed
Plum *(Prunus)*		
Black knot	Black "dead-man's-finger" on twigs and smaller branches	Remove and spray mancozeb, maneb or zineb at budbreak and 10, 20 and 30 days later
Privet *(Ligustrum)*		
Scale	Gray scales in clusters on stems	Dormant oil and malathion in May
Spider mite	Leaves turn gray with fine webbing	Dicofol, tetradifon or diazinon when first observed
Thrips	Leaves turn gray and dusty	Carbaryl, diazinon or lindane when first observed
Quince, Japanese *(Chaenomeles)*		
Aphids	Green or black slow-moving insects under curled leaves	Malathion when first observed
Lacebug	Leaves stippled with lacy insects and brown spots on lower leaf surface	Malathion or carbaryl when first observed
Leaf spot	Black, roughly-circular spots on leaves	Mancozeb, maneb or zineb at budbreak and at 10-day intervals until 2 weeks after petal fall
Scale	Round, humpbacked gray scale on branches	Dormant oil; malathion in May

Rhododendron *(Rhododendron)*

Bark scale	White cottony masses on woody portions	Dormant oil in early April; in late May and late June use diazinon, malathion or carbaryl
Black vine weevil	White grubs feed on roots and the black weevil notches leaves at night	Acephate in June; repeat 3 times at 3 week intervals
Lacebug	White stipple on upper leaf surface with brown insect droppings and lacy insects on under surface	Acephate, malathion, carbaryl or dimethoate in early June
Leaf spots	Various fungi cause brown, tan or gray more-or-less circular spots on leaves	Ferbam, mancozeb, maneb or zineb at budbreak; repeat 10 and 20 days later
Petal blight	Flowers collapse in a slimy brown mass; several weeks later white-turning-to-black "seeds" form on dead tissue	Benomyl when flower buds show color; repeat in 5 days or in wet, muggy weather
Stem borer	Branches die above areas where borers are working under the bark	Lindane on trunks in mid-May; repeat 3 times at 10-day intervals; remove dead branches

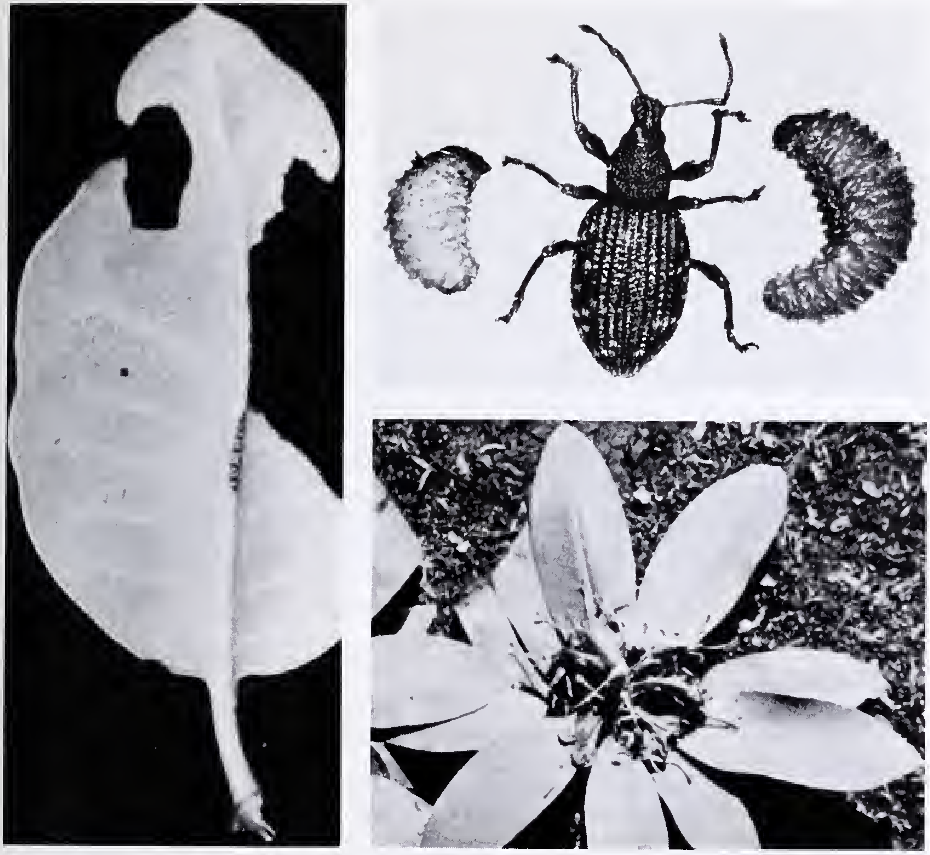
Rose *(Rosa)*

All rose pests	For best control of all rose pests and production of fine roses	A weekly program using a combination fungicide-insecticide starting in late May
Aphid	Green, slow-moving insects on leaves and flower buds	Acephate, malathion, dimethoate, Metasystox-R or diazinon when first observed
Black spot	Black spots on leaves result in severe leaf drop	Benomyl, folpet, mancozeb, maneb or zineb weekly from late May
Cankers	Various fungi cause brown or black dead areas on canes	Remove infected canes and follow black spot program
Leafhopper	Stippled leaves as result of small, fast-moving "hoppers"	Malathion, dimethoate, diazinon or Metasystox-R when observed
Midge	Buds turn black and flowering ceases	Acephate when observed; repeat in 10 and 20 days
Powdery mildew	White powdery coating on leaves and flower buds	Benomyl or folpet at 2-week intervals
Rose chafer	Tan beetles feed on flowers	Methoxychlor when first observed
Rust	Orange pustules on underside of leaves	Mancozeb, maneb or zineb at 2-week intervals
Spider mite	Leaves turn gray with fine webbing	Acephate, dimethoate, dicofol or diazinon when first observed
Stem borer	Tunnels in center of canes caused by burrowing insects	Remove injured canes; rub wax on new cuts
Thrips	Buds fail to open or petals turn brown at edges	Acephate, dimethoate, malathion or Metasystox-R when observed

Snapdragon *(Antirrhinum)*

Anthracnose	Tan spots on leaves cause defoliation	Mancozeb, maneb or zineb when first observed; repeat at 10-day intervals
Aphid	Green slow-moving insects cluster on leaves and flower buds	Malathion when first observed

l., u.r., L.M. Vasvary; l.r., S.H. Davis



Left, underside of rhododendron leaf with injury from adult taxus weevil; upper right, taxus weevil grubs and adult; lower right, rhododendron petal blight injury on an unsprayed flower truss.

Caterpillars	Various caterpillars chew holes in leaves	Carbaryl when first observed
Rust	Brown, fuzzy pustules on leaves	Mancozeb, maneb or zineb when first observed; repeat at 10-day intervals
Spider mite	Leaves turn gray with fine webbing	Dicofol or tetradifon when first observed and 10 and 20 days later
Snowball *(Viburnum)*		
Aphid	Black slow-moving insects curl the leaves	Malathion when first observed
Spirea *(Spirea)*		
Aphid	Green slow-moving insects cluster on new growth	Malathion or Metasystox-R when first observed
Spruce *(Picea)*		
Budworm	Small caterpillars web needles together and kill terminal growth	Carbaryl when new growth begins in spring

Canker	Small-to-large branches turn brown and die, as result of brown gummy canker at base of dead area	No spray control; cut out diseased branches as soon as observed
Cooley gall aphid	Elongated galls at tip of blue spruce twigs	Carbaryl, Metasystox-R or malathion as buds swell in spring; repeat in early fall
Spruce gall aphid	Galls at base of new growth on Norway spruce	As for Cooley gall aphid
White pine weevil	Leaders die with many white grubs just under the bark	Spray leaders with lindane in early-to-mid-April
Sycamore *(Platanus)*		
Anthracnose	Portions of veins in leaves turn black; defoliation; cankers on small twigs and branches	Copper, dodine or Daconil at budbreak; repeat 10 and 20 days later
Giant bark aphid	Gray slow-moving insects produce honeydew which drips from large branches	Acephate or malathion when first observed
Lacebug	Stipple of upper surface of leaves; lacy insects and brown spotting of under surface	Acephate or malathion or carbaryl in late May, mid-July and mid-August
Tussock moth	Yellow caterpillars with white tufts feed on leaves	Carbaryl in early July
Tree-of-Heaven	see AILANTHUS	
Tulip *(Tulipa)*		
Aphid	Green slow-moving insects cluster on leaves	Malathion or diazinon when first observed
Bulb rot	Leaves yellow and flowers fail	Do not plant bulbs with green, brown or black markings
Fire blight	Brown spots on leaves and deformed flowers later produce a gray mold	Benomyl when plants 3 inches tall; repeat weekly through flowering
Willow *(Salix)*		
Aphid	Black slow-moving insects causing sticky honeydew	Malathion when first observed
Blight, canker and scab	Various fungi cause spotting of leaves and twigs, twig cankers and dieback	Mancozeb, maneb or zineb at budbreak and 10 and 20 days later
Borer	Rough swollen areas on twigs and branches	Lindane in late August to early September
Willow leaf beetle	Small slug-like insects skeletonize leaves and the blue beetles chew holes	Acephate or carbaryl in late May and early August
Yew *(Taxus)*		
Black vine weevil	White grubs feed on smaller roots and the black weevil notches needles at night	Acephate, particularly on lower portions in June; repeat three times at three-week intervals
Mealy bug	White cottony insects cluster on twigs and branches	Acephate, malathion or carbaryl in late May and early June
Zinnia *(Zinnia)*		
Powdery mildew	White powdery coating on leaves	Benomyl or Karathane at 10-day intervals starting in June
Leaf spot	Black more-or-less circular spots result in defoliation	Mancozeb, maneb or zineb at 10-day intervals starting in June

AN INVITATION TO JOIN AND ENJOY

> **A man does not plant a tree for himself;**
> **he plants it for posterity.**
> **—Alexander Smith**

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....cut off here..

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BROOKLYN BOTANIC GARDEN RECORD
PLANTS & GARDENS

HOUSE PLANTS

Vol. 35 Autumn (November) 1979 No. 3

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African-violets have proven a perennial favorite among house plant growers. *Saintpaulia* 'Pixie Blue', a single-flowering dwarf, is a trailer, here grown in a 3-inch pot.

LETTER FROM THE BROOKLYN BOTANIC GARDEN

The house plant bloom has come and gone, and the time has arrived when indoor growers are more discerning about the plants they grow. Some concentrate on particular kinds such as gesneriads or cacti, and the indoor plant societies are thriving as they kindle interest, knowledge and a surprisingly high degree of sophistication in their field. Others, inspired in part by the officescaping of designers such as Everett Conklin, regard the interiors of homes as potential gardens, choosing plants and placing them in the room at least as carefully as would any landscape architect outdoors. In this connection, the many developments of the last fifteen years in artificial light gardening have been a liberating influence on where we grow house plants and what kinds. Also, there are a host of new plants that have come into cultivation, quite enough to satisfy the urges of the most avid collector or selector.

For many, though, who are just becoming interested in plants, there is a danger of being lost in the wealth of detailed information available these days and of being alienated by the highly intricate must-do's and must-do-not's of the self-appointed seers. There are indeed certain rules of the game, for plants are living things, not pet rocks, and the care that is given them is important to their survival. Luckily for plants and us, there is usually a margin for success, and we can avoid the sorts that are real fuss-budgets. It is the pleasure of growing that counts, so ignore the most highly demanding representives of the plant world unless you derive a special satisfaction from catering to them!

There have been dire predictions about the future of house plant culture because of fuel shortages and lower thermostats. As Aunt Agatha would whisper through her aspidistra, "Piffle!" True, African-violets and many of their relatives, also the bromeliads and some ferns, may not prosper, but the great majority of house plants should benefit from cooler rooms, as long as there are no drafts. Because rooms will be cool (65°F during the day, down to as low as 55° at night), the humidity will be higher, a distinct plus for plants. For years in the modern overheated home many of these plants have suffered from a condition that might best be referred to as parch.

To bring the house plant scene up to date, the Botanic Garden has been fortunate to enroll Charles Marden Fitch as Guest Editor. An experienced grower with wide interests and an unusually fine aesthetic sense, Mr. Fitch has called upon seventeen keen and knowledgeable Contributors to complete this Handbook. Many thanks to all for sharing observations and advice with readers.

Good growing—and may this be the year of the house plant for you and yours.

Sincerely,

Frederick McGourty, Jr.

Editor

Making house plants thrive by . . .

Getting Down to Basics

Brenda Weisman

Whether they are terrarium dwellers, orchids grown on slabs or just plain potted plants, all plants need an appropriate balance of light, water, air, temperature and minerals, plus sanitation and actual physical support. The factor determining this balance is the natural habitat in which each plant originally grew. Although one can easily distinguish between desert and jungle, there is a whole spectrum of environments in between which also have hosted many of our house plants. Basically what we try to do is replicate these environments in the home.

Light

Many of the garden-book lists detailing the light requirements of individual plants seem to have been compiled for unshaded desert homes on July Fourth rather than for northern homes on New Year's Day when almost anything with roots can use at least some sun or supplemental lighting. The low-light designation for a plant does not mean it can be grown in the Black Hole of Calcutta. Conversely, a full-sun requirement might not be met even by an unsupplemented southern exposure during a northeastern winter.

The limits within the light requirements for each plant must be determined by trial and error; for instance, one would not expect a light-loving geranium to bloom in a north window in winter, but it could be maintained there until moved outside in spring. Likewise, a cactus garden kept in full sun all summer could be beautifully maintained all winter with good light but no sun. The plants would become dormant or semi-dormant, with very little growth, minimal food production and lowered water use. On the other hand, many a shade-loving fern has languished in a north window in January under excellent growing conditions only to revive when given an extended sun bath.

Even in the same exposure there can be unexpected light intensities ranging from a bright, unobstructed north window to a dim south window that faces another building. Therefore, assess the available light and consult one of the newer lists for the kinds of plants likely to perform best in the location. A good list is in the U.S. Dept. of Agriculture *House and Garden Bulletin* #220 on "Indoor Gardening." This bulletin also discusses water requirements.

Because light is used to provide the total food supply of the plant, the further below optimum the light level is for a particular plant, the less food is produced and the fewer the leaves that can be supported. This is a vicious cycle because the fewer the leaves, the lower the food supply, et cetera. After a few et ceteras the plant simply expires! This is the major reason why new plants indoors drop their leaves like rose petals in a wedding procession. No matter how good the light, it is seldom as good as where the plant was raised.

For many years light was the unalterable aspect of the home environment and one had to choose plants accordingly, but this changed with the advent of fluorescent lighting. Now most serious indoor growers use some form of light gardening.

Watering

There is only one way to water any plant—thoroughly! Water should pour from the drainage hole which is preferably present at the bottom of every container. Clay pots can stand in the water for a short time until they stop 'singing'—the sound they make as they take up water, but after that, beware, for few plants should stand in water for any length of time.

Plants are divided into two major watering categories; ones that must be evenly moist at all times and others that must dry out a bit between waterings. The need for water can be determined only by feeling the surface of the potting mixture with your fingers and watering according to the category each plant is in,

Charles Marden Fitch

An innovation in plant containers is plastic molded to look like wood or thrown clay. Sturdy, easy to clean and lighter in weight are the advantages. This *Haworthia papillosa* grows well in a 4-inch pot with removable saucer.

also considering where in the home the plant is grown. This method is satisfactory for containers up to about eight inches in diameter. In the twelve-inch range probe a finger well below the surface for moisture content. With larger tubs put your hand below the side surface and feel for moisture or, better yet, use a water meter with a probe that translates soil moisture to a dial reading.

Plastic pots require watering less often than clay ones, and pots without holes need it even less often. The latter can create severe watering problems, but eventually a sixth sense about watering does develop, particularly for those plants that have been in residence for a while.

"Evenly moist" means exactly that, *not* evenly soggy. Air is excluded from waterlogged potting mixes and causes physiological problems that lead to root death. Unfortunately, too much and too little watering present the same symptoms—rapid yellowing and dropping of leaves. The mix surface should always feel moist to the touch, but when in doubt about watering—don't, until the next day.

There are several subgroups of "dry between watering" plants, ranging from those cacti and other succulents which need weeks of dryness in winter (but can take water every day in a summer out-of-doors) to geraniums which need only days of dryness before the next watering.

The most confusion occurs when we are directed to let such plants as amaryllis, gloxinia and geranium (prior to spring planting outdoors) dry out in the home during their dormant periods. This does not mean total drought! Rather, after flowering, when their leaves are no longer attractive and growth has slowed, withhold enough water to encourage a rest, but not so much that premature wrinkling sets in. To a lesser degree this is the kind of watering needed for many house plants that cease growth in the fall. When plants are not actively producing leaves or flowers, "evenly moist" may mean several dry days between watering. In the same situation "dry between waterings" can be extended several days longer.

Humidity

There is a difference between water in the pot and water in the air—*humidity*. Lack of humidity can be a cause of premature plant death. In summer, plants out of doors or in rooms without air conditioning have no humidity problems, except perhaps an occasional fungus ailment resulting from lack of air circulation. When air conditioning is introduced, however, the summer advantage is lost.

In autumn the indoor humidity plummets when the furnace goes on, resulting in atmospheric conditions like those found on a desert in midsummer. It is hardly the climate for African-violets. Unfortunately, most of us get the urge for indoor greenery at just that time of year. What a disaster it is not only to bring a plant into much lowered light, but also to keep it in such a dry atmosphere that the leaves transpire more water than they can receive from the roots. Result: leaf-drop.

Aside from creating unhealthy root conditions, overwatering cannot make up for lack of humidity in the air around the leaves. Raising humidity around smaller pots that can be grouped together is not a problem. They tend to humidify each other. Also, most experienced gardeners have learned to group pots on trays of wet pebbles—a marvelous way of raising humidity near windows over radiators and quite in keeping with home decor.

Don't believe all those pictures of blooming exotics on night tables in the bedroom. They stay there about as long as it takes to photograph them and then must be returned to a more congenial growing area. This holds for all the other charmers that are breathtaking in a decorator's photograph but which, deep in our hearts, we know can't be permanent. If the location doesn't seem reasonable, be assured, it isn't!

The giants in the house represent a greater problem. *Ficus benjamina*, fondly referred to as Benjie, is a prime troublemaker for many people. First, it seems to have some kind of natural semi-dormancy in the winter, but in addition it loses leaves when any of its growing conditions are suddenly changed. I'm lucky to be able to keep Benjie near a glass block wall on a landing that is not in the direct line of any radiator. My experience is that distance between radiators and Benjie, and other five-footers such as palms and schefflera, is the best solution for winter care.

The value of misting house trees is almost negligible because the water evaporates so rapidly. A good way to have a forest indoors is to get the plants into the house well before the heating season; keep them at the upper limits of their light requirements, and out of radiator range. It also helps if the commercial growers and dealers have adapted the plants to house conditions before selling them, a process called acclimation. One of the benefits of energy conservation is that the cooler the air, the higher the relative humidity. Some enormously satisfied house plants are resulting from lowered thermostats.

Temperature and Soil

I take a pragmatic approach toward temperatures for plants. Either the plant finds a spot to its liking, within the limits of my comfort range, or we part company. The greenery is more adaptable than I am, but I do have rooms with the three temperature ranges into which plants are placed according to their *winter* night requirements—cool (up to 55°F), intermediate (55°-to 65°F) and warm (over 65°F). These ranges should be an important consideration when choosing plants.

Window areas are cooler than the inner room on winter nights. Cool to intermediate growers often thrive in such a location. Protect them from cold either by moving them farther into the room at night, by placing a barrier between them and the window, or by placing them only in insulated windows. Plants should have an 8-10° drop in temperature at night. In summer, plants thrive at any reasonable

J. Horace McFarland

Brilliant colors, good blooming and scented foliage have contributed to the two-century popularity of the geranium (*Pelargonium*).

temperature in a window or out-of-doors, if exposed to gentle breezes and high humidity.

Soil anchors the roots and provides them with easy access to air, water and minerals. In the good, old, uncomplicated days there was one standard soil mix consisting of one part "good garden loam," one part builder's sand or bird gravel, and one part peat moss. Less peat moss and more sand was used for geraniums, succulents and other types from arid habitats. More peat moss was used for begonias and other jungle plants. It was a light, well drained growing medium, but complications have set in! There are commercially packaged mixes for every purpose, and it is sometimes difficult to tell whether there is soil in a pot at all.

A discussion of the various mixes, many of which are soilless, is beyond the scope of this article. They are well covered in Charles Marden Fitch's *Complete Book of House Plants*. One should choose a mix based on its advantage in a given situation. For instance, the lightweight mixes are wonderful for balconies, decks and shelves where weight is a concern. However, they may cause a problem for the long-weekender because they drain so readily that constant attention to water and fertilizers is essential. Also, soilless mixes are poor anchors for large plants.

With a few exceptions, I still use my original soil mix and its simple variations, but I provide excellent drainage (the best solution to overwatering) by adhering to the proportions mentioned above and by incorporating shards or pebbles in the bottom of the pot. No matter what potting medium is employed, don't pack it in with a pile driver. A gentle patting into place, then watering, will suffice. Anything more vigorous causes compaction, particularly of soil mixes.

Fertilizing

Contrary to popular opinion, we do not feed plants; they feed us. Basically, we supply them with the minerals (fertilizers) that aid photosynthesis and other life-processes. The mineral nutrition of plants is probably the most misunderstood area of plant care. Most people regard fertilizer as the aspirin of the plant world—to be administered indiscriminately to ailing plants.

Any plant not in active growth, whether sick or dormant, cannot make use of added nutrients, mainly nitrogen, phosphorus and potassium. In fact, roots can be burned and rot as mineral salts build up in the pot. Unless conditions are so good, as in a light garden or greenhouse, that a plant is in active growth all year, fertilization should cease in September and not begin again until the spring flush of leaves appear. The addition of nutrients during dormant periods can be deadly. The one exception to this would be for soilless potting mixes, but even then the use of fertilizers should be diminished in winter. (To avoid getting confused about the kinds of house plant fertilizer, consult the excellent list in *Plants & Gardens,* Winter, 1978-9, page 54.)

Vacations

There are two kinds of vacation: one for plants, the other for people. A plant vacation is a summer out-of-doors from the end of May to the beginning of September, except for gesneriads whose leaves get spotted and tattered, or any little things in tiny pots that often get lost. Shade lovers go directly to shady areas, but sun worshippers must be moved gradually or severe sunburn occurs.

Before being brought back indoors, everything is cleaned up and/or repotted, but do be warned that a summer outside can mean an explosion of insect problems in the winter, more severe than if the plants had stayed home.

The summer vacation is a mixed blessing in other ways, too. The plants usually thrive outside but often drop leaves when brought back to the artificial climate of the house. This is particularly true of coleus. If the plant has also been blooming all summer, it cannot be expected to do so all winter without some kind of rest. Geraniums and begonias react similarly. They all should be cut back severely in mid-August and either the cuttings used for new plants or the old plants repotted, started up again and placed indoors. Fuschias manifest the typical dormancy situation. After blooming all summer, they should be cut back and re-rooted from cuttings through the winter, or else the original plant should be barely watered, then started up again in February. These few plants are mentioned because most back-from-vacation problems center around them. Judicious pruning is not just for the summer, but for any time that a plant gets straggly or overgrown.

Vacations for people can be anything but—for the plants in their care. There are some neighbors and relatives who are better with plants than we are, but they are very elusive, especially at our vacation time. I feel more comfortable with the bath tub and plastic tent method described in *The House Plant Primer,* BBG Handbook #70. It can maintain plants for up to three weeks. After that, some attrition can be expected. Before a short trip of three or four days, I just water a little more heavily and take my chances. For a vacation of one to three weeks, the large pots are watered as usual and left. The smaller pots are grouped together on their pebble trays in good light but no sun, and I create terrarium conditions for them with plastic tents. Plants and longer vacations are incompatible unless there is someone to provide knowledgeable care. In many areas, lengthy summer vacations require the use of air conditioning, or the plants will cook.

Acclimation

One day soon, home gardeners will start to ask whether the plants they are buying have been acclimated. That is, did the grower and seller attempt to duplicate indoor conditions so that the plant does not go into shock, or was the plant grown 'hard' with full sun, heavy watering and heavy fertilizing for quick sale to the northern market? Such fast grown, lush specimens are the plants that come into our homes, and go into a sudden decline even though conditions seem ideal.

Fortunately, there is a concerted effort being made in Florida and California, the main growing areas, to consider the final destination of the plants, and eventually all acclimated plants will bear a label identified only with those commercial growers, anywhere in the country, who produce them. Needless, to say, the success of such a program depends on the buying public. ☘

Charles Marden Fitch

Basic information about . . .

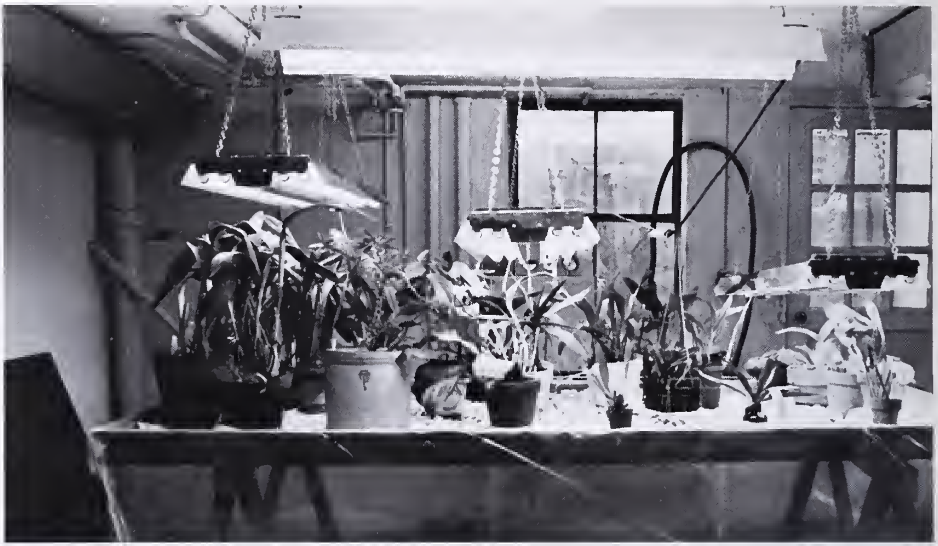
HOUSE PLANTS UNDER LIGHTS

Charles Marden Fitch

Using fluorescent lights to supplement daylight or to create indoor light gardens gives one freedom to grow house plants almost anywhere. Some of my most beautiful tropicals are grown in the basement under fluorescent lamps. When the plants are at their blooming best they are given display space in the living room, on a dining room table or in a similar prominent location. Such a system lets me utilize space in an already heated, easily accessible place where I only have to provide adequate light and humidity.

Friends of mine have built virtual greenhouses in their basements, thus having no trouble from storms, cloudy days, extra cold weather—or excessively high heating bills. Even more exciting are attractive light gardens designed to be a decorative part of an indoor living area. For example, a feature of my own living room is a wall-mounted light garden kept in good condition by a combination of early morning sunlight and three 40-watt fluorescent lamps. This particular unit is made by a commercial firm (Marko Company) specifically as a light garden that will fit into decorated interiors while still providing sufficient illumination for sturdy growth of flowering house plants. It is forty-eight inches long and twelve inches high, a size quite compatible with the average room.

Light gardens in living areas, as contrasted perhaps with those in spare rooms or the basement, should be designed as



Charles Marden Fitch

A sturdy plywood lipped table, lined with waterproof plastic and filled with gravel that is kept moist, is surmounted by lights at different levels to meet the light requirements of various sized orchids.

attractive features where plants can be seen at their best. To avoid glare from the lamps a wedged louver can be used just under the fixture. A louver with a waffle-type pattern of holes permits most of the lamp light to fall directly upon the plants but will prevent direct viewing of the bulbs from the side or above. Some manufacturers offer indoor light gardens already equipped with these wedged louvers. You may also obtain the louver material for use in custom-made light gardens in hardware stores.

Several portable light gardens resembling furniture are offered in catalogs and at garden shops. Those with only one or two lamps are suitable for foliage plants and certain flowering subjects with low-light requirements such as African-violets, especially if the light garden can be placed where plants receive some supplemental daylight.

Light garden carts with two to four tiers, each carrying a waterproof shelf under an efficient fixture, are very practical for growing plants in a limited space. Although the basic design of the tiered light gardens is more functional than decorative, one can customize these units to suit personal taste. For example, I didn't like the shiny metal on one of my tiered units, but a can of metal paint let me change the impression immediately. Vines and trailing plants can be effectively used to soften the edges and hide unattractive features of a light garden. One might also build a shell or false front to enclose the functional tiered light garden.

Whatever the design, one must allow for adequate air circulation. Except for propagating cabinets where a constant high temperature might be an advantage, the usual light garden should be kept between 60° and 75°F. Since the ballasts required for fluorescent lamps generate heat, there must always be some way for this heat to escape. If a light garden is enclosed, provision must be made for ventilation, such as an open top or drilling a number of holes (perhaps in decorative shapes) around the base and sides of a cabinet.

Humidity

Extra humidity can be furnished in a light garden by growing plants on moist perlite or gravel. Roots will escape through the container drainage holes, however, making rearrangement of the pots difficult after a few months. Such outside rooting can be prevented if pots are placed on saucers or a wedged louver above the moist material. In fact, with truly waterproof trays under the plants one can keep an inch or two of water in the tray, then place pots on a wooden or wire grid above this miniature "lake." Normal evaporation of the water will furnish extra humidity. Caution: plant roots should never be waterlogged.

Light Choice

Indoor plants will grow under all of the commonly available fluorescent lamps. If natural color is very important, as in a dining room, you may want to use lamps that have a color similar to noon sunlight. Among such kinds are Vita-Lite and Verilux, both of which are broad-spectrum lamps. Cacti and orchids are some of the high-light requirement plants that thrive under broad-spectrum lamps, provided that intensity is adequate.

For slightly warm tones, but an excellent spectrum for plants that are grown for their flowers, choose one of the horticultural broad-spectrum lamps such as Agro-Lite or Wide Spectrum Gro-Lux. These are more expensive than common household lamps such as Cool White and Warm White, but they furnish a better spectrum of light for those plants which grow better under such illumination.

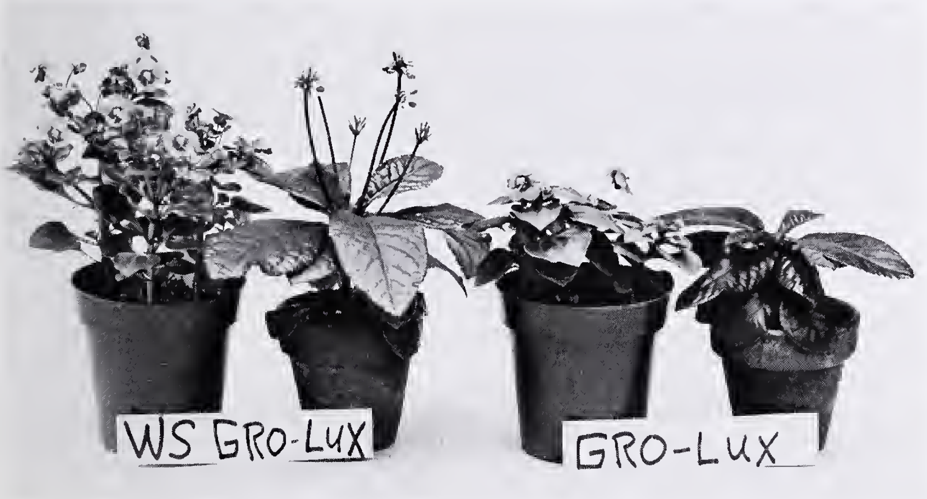
Most foliage plants and African-violets will do perfectly well under a combination of one Cool White and one Warm White fluorescent lamp, so if budget is an important factor you will want to choose these least expensive lamps for such plants.

A "theatrical" impression is created by Gro-Lux lamps, the first and most famous horticultural lamps. Standard Gro-Lux lamps cost more than the Wide Spectrum Gro-Lux, but they are the only ones that have a deep pink color. The warm-colored light makes flower and leaf color glow. Rex begonias and African-violets look spectacular under standard Gro-Lux lamps, as do red-toned orchids. Plants grow compactly under them, too.

Distance and Other Points

High-light-requirement plants such as most orchids, succulents and bromeliads look best with foliage two to six inches under the lamps. Keeping the plants too far away means that the light may be too dim for maximum flower production and compact growth. House plants with lower

The Wide Spectrum Gro-Lux tube creates a more balanced light for general mature growth and blooming. Standard Gro-Lux produces very compact, sturdy plants but they don't bloom as abundantly or as soon.



Charles Marden Fitch

M. Joyner

Sunk in a charcoal-black wall and lined with medium-gray ceramic tile, this recessed light unit becomes a dramatic focal point in a dining-room wall.

light requirements, such as foliage plants, rex begonias and African-violets, will thrive ten to fifteen inches under two to four lamps. Since light diminishes at the ends of fluorescent lamps, it is more efficient to use the longest lamp possible, rather than put two smaller lamps end-to-end.

For plants with high-light requirements, provide a minimum of four lamps per fixture for optimum growth and flowering. My basement fixtures each have four 40-watt lamps. For orchids and succulents I use all four, but for foliage plants and African-violets I use only two. Plants given too much light grow compactly, may not display flowers correctly and often have a sickly yellow appearance. Plants given too little light intensity will lose character by growing spindly and elongated, lack color or turn very dark green. Plants provided with the correct intensity look well balanced, have the color and shape characteristic of the species and display flowers without having unduly elongated stems.

The best way to time light-garden hours is with an automatic timer to turn the fixtures on and off, according to your program. Most house plants grow well with a fourteen to sixteen hour day. In the winter one might turn the timer to provide an eleven to twelve hour day, which is required by a few plants such as rhizomatous begonias if they are to bloom. After two months of short days (eleven hours) begin a long-day cycle again, so that by spring the light garden is receiving fourteen to sixteen hours of light.

Learn More

Detailed suggestions concerning this subject, plus designs for several indoor light gardens, will be found in *The Complete Book of Houseplants Under Lights* (Charles Marden Fitch, Hawthorn Books), available at most libraries. Some of the lamp manufacturers, such as Duro Test (Vita-Lite) and Sylvania (Gro-Lux), offer free folders with light garden suggestions.

If you wish to learn more about this kind of gardening write to the Indoor Light Gardening Society of America, c/o Horticultural Society of New York, 128 West 58th St., New York, NY 10019. The Society has many local chapters where members are pleased to provide personal advice. The bimonthly magazine *Light Garden* always has several articles for beginning light gardeners, plus useful addresses for light garden supplies. ☘

Happy ending, tough beginning . . .

HOUSE PLANTS IN APARTMENTS

Floss and Stan Dworkin

We believe in happy endings—and certainly our own gardening experience has shown us that despite the problems, difficulties and hazards of growing plants in an underlit, underhumidified and overheated apartment, it is an experience full of learning and of happy endings.

Gardening in an apartment is full of pitfalls, though you may prefer to think of them as aids in character development. Aside from the previously mentioned problems of light, humidity and temperature, apartments are often handicapped by a lack of growing and working space, pollution (plants filter some pollutants out of the air; on high-pollution days, our apartment always smelled better than the street), and unappreciative neighbors. Though our neighbors may disagree, we happen to think the sound of water dripping down from our windowsill to their air-conditioner is romantic.

Fortunately, most of the problems of apartment gardening can be solved and, on the way, we can improve not only our growing area but our own life.

Light

When we lived in a seven-room apartment on Manhattan's West Side, probably the most startling thing to most beginning gardeners who came into our apartment, aside from the sheer number of plants we grew, was our fluorescent-light units. Our foyer, six feet wide and twenty feet long and, of course, windowless, was lined with wood-and-stainless-steel light trays; and our living room, windowed, but at the end of a deep court and opening onto a brick wall ten feet away, sported racks of steel shelving converted into light units. These two areas would have been impossible to grow plants in but for the fluorescent lighting.

In another room, where the light was generally good, a dark corner was turned into a plant nursery with a bank of single-tube, 12-inch fluorescent fixtures, set close together, one above the other, especially for starting seedlings. Finally, in this same bright room, there were light trays for growing orchids, anthuriums, gesneriads and many others, in a *combination* of natural and fluorescent light—an excellent pairing for flowering the difficult-to-flower.

Of course, our electric bill—even in those halcyon days before oil crises—was staggering. The meter-reader left us love notes from the utility company. But there was little choice for us: either we grew under lights, or we grew only those few plants that would grow in our insufficient natural light.

Temperature

Stay cool (not cold, but cool). Most house plants grow better for being a few degrees cooler than we humans find comfortable. But, usually, older apartments lack thermostats. To control temperature we opened our windows at the top, even in cold weather. We shut radiators off completely in some rooms. A building holds heat; you're unlikely to freeze if a room or two has its radiator turned off.

At the other extreme, you can grow great plants in cool, bright apartments. Cool-growing orchids, camellias and flowering cactus plants thrive in rooms where light is bright but temperature is low.

Humidity

If a room is too dark, you have to turn the light on; if a room is too warm you perspire; but if humidity is too low, you may wake up in the morning with chapped lips or a sore throat and never know why, and the leaves of your plants will turn yellow and fall off.

Low humidity is the invisible enemy, but none the less deadly for that. Put pebble-filled trays over your radiators.

Any waterproof tray that allows the heat through to the water and gravel inside will do. This includes plastic refrigerator trays, Pyrex baking dishes, cookie sheets with rims and galvanized-iron trays that can be made to order. The water absorbs the heat and gives off moisture into the air.

Grouping plants together allows them to use each other's water vapor. They also benefit from misting with a good pump sprayer (not a used Windex bottle). However, the most satisfactory way to get a dry apartment up to par is to install a console humidifier. Get one that holds about ten gallons, then shuts off when a proper humidity (30 to 40 percent for most plants) is reached, or when it runs out of water.

Space

If you have a "modern" apartment, that is, one without windowsills, hang plants. Anything can grow suspended, including cacti. A friend with that kind of problem had the superintendent set up a chain across his thirty feet of bright windows. The chain was supported at four points and dozens of plants were hung from it.

If you can't screw hangers into your walls, perhaps you can fasten them to the moldings. Also, sturdy bird cage hangers are useful for holding plants by a window.

Further Thoughts

We painted all our walls white. Within a few months some plants that never flowered before were flowering. White reflects light and effectively increases the light falling on your plants.

Cities are sooty, and apartment windows must be washed frequently to get rid of the soot and maximize the light. Plants should be washed, too. This keeps their leaves free of dust as it helps cut down the insect population.

We do not spray our indoor plants with chemical pesticides. Sanitation (showers, removing dead or sick leaves, and so on) goes a long way in keeping bugs under control. When you first bring plants into the home it is important to isolate them. If you can manage nothing else, keep them in a plastic bag until you're sure your new acquisitions are pest-free.

We solved most of our insect problems by releasing ladybugs into our light gardens. They even got rid of whitefly.

Growing Appropriate Plants

If you've done everything you can to upgrade your conditions and they are still terrible for plants, then you can do one of two things: move, or grow plants appropriate to your apartment.

Everybody loves the weeping fig (*Ficus benjamina*), but it will only grow well in a bright, preferably sunny location. Screwpine (*Pandanus veitchii*) is an excellent apartment plant and, if you start it young, it will adapt to moderate light.

Many rhizome-type begonias will grow quite well on a windowsill in natural light (even somewhat-blocked east light). Mis-

Tolmiea menziesii, the piggyback plant, will perform satisfactorily, if not spectacularly, in the subdued, diffuse light of an apartment that doesn't face south.

Roche

The Crown-of-thorns (*Euphorbia milii splendens*) will flower for up to six months or more a year in a sunny window or under good artificial lights.

tletoe fig (*Ficus diversifolia*) is also good as a windowsill plant, requiring less sun, less water, and less humidity than most ornamental figs.

Of course, dracaenas, except for *D. marginata* 'Tricolor', do well in apartments without bright sun. Dieffenbachias won't perform adequately in poor light. Try pony-tail plant (*Beaucarnea recurvata*) for almost any bright window.

If the light in your apartment won't even qualify as "moderate" then don't be stubborn. Switch to plants that will grow in low light. *But* low light does not mean a black hole. If a specific location is too dark to read or sew by comfortably without supplementary lighting, it is too dark to grow a plant in. Try a statue instead. Statues don't have to be watered.

The best of the low-light candidates for our plant penny is the cast-iron plant (*Aspidistra elatior*). Move it up to a large pot and it will eventually grow large. But it does endure. Grape-ivy (*Cissus rhombifolia*) and kangaroo vine (*C. antarctica*) tolerate low light but won't grow well that way. Be careful watering cissus plants: in bright light they take a lot of water, but in low light they should not be allowed to sit in a puddle for any length of time.

Spathiphyllum blooms in fairly low light, but not if repotted frequently. Keep it rootbound for flower production and give it plenty of water. Too little water causes leaf loss. The plain green-leaved Chinese evergreen (*Aglaonema*) will do well in low light, but the variegated sorts will not.

A few of our light-garden apartment favorites have been: Egyptian star-cluster (*Pentas lanceolata*) and prostrate crown-of-thorns (*Euphorbia milii prostrata*). They flowered every day of the year in our hall light trays; miniature sinningias, *Koellikeria erinoides* (a gem!) and other gesneriads thrived in terrariums; basket grass (*Oplismenus hirtellus*) all but took over one light tray. And we became very fond of bromeliads. They were the only long-flowering plants that allowed us a long vacation with no care.

We started with a happy ending, and so it's appropriate that we end with an introduction: "Apartment gardeners, meet plants; plants, meet apartment gardeners. We think you'll get along just fine." ❧

For healthier and happier plants . . .

CONTROL OF HOUSE PLANT PESTS

William F. Munk

Healthy and vigorous plants growing under optimum conditions are usually more resistant to attack by insects and diseases than are ones growing under stress. Therefore, when you purchase a house plant try to simulate the growing conditions of its original habitat, regarding light, humidity, temperature and water. For example, a plant that grows on a desert with bright sun most of the year should be placed in a warm sunny window. The soil should be sandy, well drained, and kept on the dry side. This plant would weaken and become susceptible to insect and disease attack and eventually die if potted in a heavy, poorly drained soil and placed in a dimly lighted area.

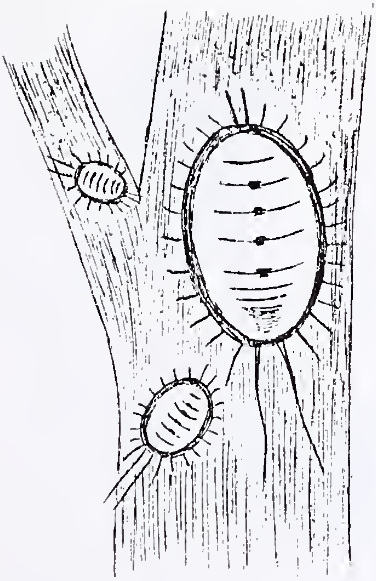
House plants should be *observed* closely for the appearance of insect pests to help prevent a buildup. When pests are seen, spot spray with a suitable insecticide or wipe them off the foliage with a damp cloth or cotton swab dipped in alcohol. Forcefully syringing plants every couple of weeks with water should discourage insect pests and also clean dust off the foliage. Severely infested plants may have to be discarded, for it is very difficult to eradicate the pests once a buildup occurs. The major pests of house plants are aphids, mealybugs, scale, spider mites and white flies, all of which suck out plant juices. Except for spider mites, these are in the insect order *Homoptera.*

Aphids, Mealybugs and Scale

Aphids are small, soft-bodied, pear-shaped insects about an eighth inch long with or without wings. They can be black, brown, green, yellow or reddish. They secrete "honeydew" or sticky drops on foliage or surfaces beneath the plant. Aphids usually frequent tender young plant growth and flower buds. They suck out the plant juices causing leaves and flowers to become stunted. Aphids rarely kill plants, but they can spread virus diseases from one plant to another. Aphids also cause leaves to curl. A strong spray of water will wash most of them off. A spray of one or two teaspoons of 57 percent malathion insecticide to each gallon of water controls aphids. The most readily infested plants are dieffenbachia, fatshedera, ferns, ivies, and pittosporum.

There are several species of mealybugs that attack house plants. Mealybugs are soft-bodied, white to beige in color, and appear as if they are dusted with flour because of their waxy covering. They grow about 3/16 of an inch long. Some have waxy filaments extending from the rear of their body. Mealybugs can be found at rest or crawling slowly on stems and in the axils of, and on the undersurfaces of leaves. Mealybugs suck out plant juices and may cause stunting of the plant. In severe infestations they may kill plants. Some mealybugs live in the soil and feed on roots. Plants especially subject to mealybugs include Africa-violets, aphelandra, citrus, coffee, coleus, croton, dracaena, gardenia, jade plant and schefflera.

To control mealybugs, the lower and upper surfaces of plants may be sprayed with either malathion or dursban. Use two teaspoons of 57 percent malathion liquid concentrate to a gallon of water (don't use wettable powder because it does not penetrate the mealybugs' waxy covering); or use two teaspoons of 2 percent dursban to a gallon of water. Dursban gives more effective control. You may be able to control mealybugs on just one plant or a few by hand picking or removing the insects with a cotton swab dipped in alcohol. Washing plants with soapy water and a soft brush or cloth may be all that is necessary to remove them from broad-leaved plants. Use two teaspoons of a mild detergent to a gallon of water. Volck Oil spray is also effective in controlling mealybugs.


Author

Mealybugs

There are several species of scale insects found on the leaves and stems of house plants. Being closely attached to plant surfaces, they almost appear to be part of the plant. They have a shell-like covering or scale that protects their entire body. Most scale insects on house plants are about 1/16 to 1/8 of an inch long and have a spherical or oval shape. Their color ranges from white to black, but brown and grays are more common.

Scale insects feed by sucking plant juices. This feeding causes poor growth or stunted plants. Severely infested plants can die. Scales secrete droplets of a sweetish, sticky liquid called "honeydew" which makes the leaves shiny. A wide variety of house plants are attacked. Among the most susceptible are citrus, coffee, dieffenbachia, ferns, ficus, gardenia, palms, pittosporum and spider plant.

Scale insects on house plants can be controlled by spraying them with one teaspoon of 57 percent liquid concentrate of malathion per gallon of water. Several applications at intervals of three or four weeks may be necessary. Volck Oil spray also controls scale. If only a few scales are present, they can be removed by using a soft toothbrush dipped in soapy water. Brush the plants at weekly intervals until the problem is controlled. Scales may cling to plants for a month or more after they are dead. Living scales will exude some juice when crushed. Dead scales become dry and chaffy.

Scale

Eva Melady

Spider Mites, White Flies and Others

Spider mites are one of the most common and bothersome pests of house plants. They are members of the Spider Family, not true insects. They thrive in warm dry homes. At temperatures of 60°F and lower, reproductive activity of spider mites is very low. Although they can barely be seen with the naked eye (about 1/100 of an inch), a heavy infestation can stunt plants and sometimes cause complete defoliation.

The first visible signs of spider mite damage are yellow or brown speckled areas on the upper surfaces of the leaves. If you turn a leaf over you may see the mites and the fine white webs they spin. The webs can cover the plant if mites are not controlled.

As mites continue to feed by sucking out plant juices, the leaves become bronzed or yellow and may die or be shed. Aphelandra, aralia, asparagus-fern,

Aphid

Eva Melady

cyperus, dracaena, ferns, pittosporum, schefflera and piggyback plant (*Tolmiea*) are favored foods.

To control spider mites on foliage plants, spray them with kelthane or malathion used according to the manufacturer's directions. Be sure to wet the undersurface of the leaves. On tough sturdy plants, a forceful spray of water should be used to break up the webs and dislodge the mites before the insecticide is used. Lowering temperatures to 55° to 60°F will also slow spider mite development.

White fly adults resemble tiny white moths. Their wings are usually covered with a white substance. If you shake an infested plant, the white flies will flutter about. The immature white fly nymphs resemble scale insects. Crawlers are found mainly on the underside of the leaf. Damaged is caused mainly by sucking of sap from the plant by the nymphs. Heavy feeding by the nymphs results in yellowing and drying of foliage, and weakening and death of severely infested plants. The nymphs produce honeydew, which covers the leaves and imparts a blackened appearance—a result of the sooty mold fungus that develops on the honeydew. White fly nymphs are very difficult to eradicate. The insecticide Resmethrin can be sprayed on infested plants weekly according to the manufacturer's directions until control is achieved. Heavily infested plants should be discarded. White flies can severely infest fuschia, geranium, lantana and poinsettia.

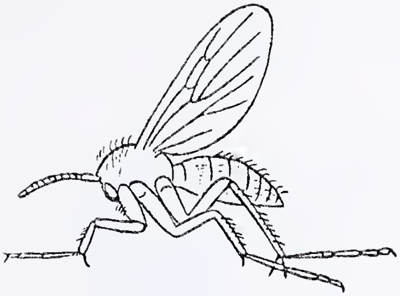
Major injury can occur in house plants infested with fungus gnat maggots. Fungus gnat maggots are slender white worms about 1/4 of an inch long. They live in the soil and feed on roots that are beginning to decay. They will also attack living roots present in wet soils and those soils rich in organic matter. They feed on the crowns of plants, too. Severely injured plants grow poorly, drop their foliage and appear off-color.

To control maggots, the soil surface can be drenched with a lindane solution, mixed with water according to the manufacturer's directions. Apply the solution to the soil surface in the amount that is required for watering plants. One treatment is all you need for adequate control. It is not necessary to apply insecticides to the leaves of the plants. Diazinon also gives good control of the maggots when used as a soil drench.

Fungus gnats are small grayish flies that you may see around windows and lights. Adult gnats cause no damage to plants but are a nuisance in the home. You can get rid of them by using a household aerosol spray containing malathion.

Springtails are small white insects which jump or hop. They are quite common in house plant soil, feeding on decaying organic matter. They do little harm to plants. Their presence is usually a sign of overwatering, as they prefer wet soils. Let soil surface dry between waterings. A soil drench of diazinon insecticide, used according to the manufacturer's directions, should kill springtails.

Diseases are not too much of a problem



Fungus gnat *Author*

on house plants. This usually is due to the generally low humidity found in the home. There are some exceptions, such as fungal and bacterial leaf spots which attack various philodendrons. Begonias are very susceptible to mildew and leaf spot fungi, so avoid misting these two groups of plants with water, because the higher the relative humidity the more likely these diseases are to develop. Also, a suitable fungicide such as Benlate periodically sprayed on these plants will help prevent problems.

A Few Cautions

The pesticides mentioned in this article are safe for the homeowner to use, provided that they follow the manufacturer's directions and cautions when using the chemicals.

Note: Many pesticides can be injurious to particular plants. For example, malathion can damage jade plant (*Crassula*). The list of plants injured by a particular pesticide is too long to include here, so, before using a pesticide on a particular plant, either contact a county extension agent or inquire at your plant dealer or area botanic garden to be sure that it is safe to use. Or spray just one or two leaves with the pesticide. If no injury occurs after a few days it should be safe to use on the entire plant.

To conclude, here are a few hints to help prevent insects, disease infestation and environmental problems on house plants: provide optimum growing conditions; avoid overwatering, provide adequate light (but direct sunlight especially in spring and summer can injure foliage plants), and do not place most foliage plants in warm, dry locations; do not allow plants to become too potbound or suffer other types of stress.

Last, but of great importance, purchase plants that are to the best of your knowledge free of insects and diseases. All you have to do to begin an infestation is bring into your home a single plant that has mealybugs or scale. Of course, insect pests can also be brought home on clothes, animals, fruits and vegetables, so always be on the alert. You should have healthier and happier house plants by following the suggestions in this article. ❧

Spider mite

Eva Melady

POTTED TREES FOR MODERN INTERIORS

Ernesta D. Ballard

Contemporary houses and offices, with their broad expanses of glass, are well suited to growing plants, and often need masses of foliage to relieve their austerity. To satisfy this need, growers are producing increasing numbers of tropical trees in pots and tubs. In my experience, these trees make more satisfactory decorations for spacious modern interiors than the split-leaved philodendrons or the totem poles of *Philodendron cordatum* often sold for the purpose. True, trees are likely to be more of an investment—sizable greenhouse-grown specimens are costly to produce and southern-grown trees are expensive to ship—but they are also easier to care for, and they will retain their attractive appearance much longer.

When you first consider an indoor tree, don't be discouraged if it does not have foliage all the way down to the pot. The bare base of a philodendron totem is admittedly unattractive, but the trunk of a tree, clearly defined and often interestingly shaped, gives the tree character and stability.

Consider, also, the container. This need not be the cumbersome, graceless pot in which most plants are sold. For the plants pictured in this article, comparatively small pots were chosen to complement the plant in color and proportion. The decorative effect is heightened by covering the soil with moss or pebbles.

Of course, a hand-crafted Japanese pot can be expensive. However, it is perfectly possible to keep a tree growing in the same container indefinitely, if the roots and top are pruned at intervals, as described farther on in this article. Thus, the pot can be considered a long-term investment.

Be sure to buy a pot with a drainage hole. Jardinieres and planters without drainage holes should be used only if the tree is already in a pot with drainage and this in turn is placed on a layer of pebbles or shards inside the jardiniere. Even with this arrangement, care must be taken never to fill the jardiniere with water above the bottom of the interior pot. If the roots of any plant become waterlogged, the plant will die.

If you are not a skilled horticulturist, seek expert advice in deciding what species of tree to buy. Generally speaking, if the place selected for the tree is sunny, your choice is wider and can include flowering and fruiting species such as the orange. Locations without strong light are suitable only for dark green foliage such as the fiddle-leaved fig and schefflera which grow naturally in the shady forests of the tropics. Bear in mind that it is the amount of natural light that controls your choice; artificial light is almost never adequate for year-round growing. Out of the numerous species of trees described here, at least one will fit almost any location indoors where plants might be grown.

As an indoor tree grows from year to year, new growth will appear at the growing tips, and the older, lower leaves will yellow and eventually drop off. How long this takes depends largely on the species. Leaves have lasted four years on my fiddle-leaved fig, while those on my orange tree rarely last more than one.

Pruning Methods

At some point, pruning will be necessary to keep the tree to a reasonable size and to encourage new branches along the stem to replace fallen leaves. In the axil of every leaf there is a bud capable of developing into a branch. On most trees these embryo branches can be induced to develop by pruning the tips of existing branches and the main stem. In the case of flowering and fruiting trees, pruning also produces more and better blooms and fruit. Palms alone will not respond to pruning. If you cut the growing tip out of a palm tree, the stem will die.

Pruning principles are the same indoors as out. If two branches cross, one should be eliminated; dead wood should be re-

Silk-oak (*Grevillea robusta*) grows quickly and responds readily to pruning. The finely cut foliage lends a feeling of tropical opulence to a sunny room. This fifteen-year-old specimen is top-dressed with polished Japanese stones.

moved; crowded branches should be thinned out so the basic pattern of the tree is clearly visible; and a balance should be maintained between the roots and the top. Your eye, your sense of design, and your courage will help you decide where to cut.

Root pruning is as important as top pruning in the care of potted trees. Every year or two, I remove my trees from their pots to see if the roots are crowded. If they are, I loosen and untangle those on the outside of the root ball for an inch or two; prune the untangled roots away; and replant the tree in its container, using an appropriate soil mixture to fill the space around the reduced root ball. Poke the new soil into place with a stick to be sure no air spaces are left, and soak the soil thoroughly when you are through.

Concurrent with root pruning, a corresponding amount of foliage and branches must be removed from the top to compensate for the lost roots.

All plants—and trees are no exception—fall prey to pests. If the decorative effect of your potted tree is not to be spoiled by the sticky residue of scales, mealy bugs, and aphids, or by the yellow mottling of spider mites, you must spray

Edmund B. Gilchrist, Jr.

Fiddle-leaf fig (*Ficus lyrata*) is kept room-sized by judicious pruning. This fifteen-year-old specimen has six branches with leaves a foot or more long.

Author

The Ponderosa lemon (*Citrus limon* 'Ponderosa') has leaves and fruits larger than is usual in pot-grown citrus. The fruit is edible, but extremely sour.

regularly with a proper insecticide and miticide such as those discussed on page 16. The use of an aerosol pesticide makes spraying much less messy than it used to be, but it is not always practical for large trees. If aerosols are not feasible, the tree should be in a location where a regular spray will not stain wall paper, curtains, or inaccessible glass, or else it must be small enough to be moved into a suitable place for spraying.

The best way to keep your tree alive and beautiful, and to safeguard your investment, is to put it outside for at least two months between May 15 and September 15. The increased light is often all that is required to induce budding and the development of new foliage. But except for trees that have been growing in full sun inside, don't make the change too abruptly. Move the trees gradually from the low light of indoors to high, dappled shade and finally to full sun, taking ten days to two weeks for the complete transition. In the case of jungle plants, stop when you get to high, dappled shade. Don't ever put them in full sun. If high shade is not available, the north side of a building will do just as well.

The following are a few generally available trees I have found satisfactory. There are, of course, many others that will do well indoors. Included also is a so-called "bromeliad tree," which is not a tree at all but a stump planted with bromeliads. It will be just as satisfactory as a tree in many locations.

Brassaia actinophylla

SCHEFFLERA, UMBRELLA TREE

The whorls of dark green leaves, large in proportion to the trunk, give the umbrella tree an imposing appearance. This tree, five to six feet tall, is strong and bold enough to be used as decoration in a very large room or entryway where a smaller, more airy tree might be out of scale with the surroundings.

Plants are available in a wide range of sizes. Usually two, three, five or more plants of different heights are set in a single container. It is very difficult to induce branching in scheffleras. When the top is pruned, a single new shoot develops just below the cut and soon grows to replace the tip that was pruned away, leaving a barely visible scar.

The better the light, the better the plant will do, but winter sunlight is not entirely necessary. A water-soluble fertilizer should be applied monthly from spring to fall.

Chamaedorea elegans (*C. e.* **"Bella"**)
DWARF PARLOR PALM

This is the plant which florists grow by the millions for terrariums, dish gardens and small house plants. *C. elegans* grows slowly increasing in height about an inch a year, making it a good candidate for small interiors. The trunk gets thicker but, because there are no branches, the leaf area is always about the same. The best feature is the flowers. Each winter, three to six flower stalks appear and bear hundreds of tiny round yellow berry-like flowers which fall off in a few days.

Chamaedorea seifrizii, another fine palm of the clump type, has dark green leaves and narrow stems resembling bamboo.

Citrus

Citrus trees—oranges, lemons, limes, calamondins, kumquats and tangerines—are among my indoor favorites, for they are seldom without either sweet-smelling flowers or ripening fruit. Oranges, lemons, limes and tangerines grow four or five feet high over a period of ten to twenty years. Calamondins and kumquats stay small and can scarcely be classed as trees. Be sure to get a plant that has been propagated vegetatively. Seedlings seldom bloom.

Ideally, citrus trees should have four to five hours of winter sun, six to eight hours of summer sun, and night temperatures ranging anywhere from a winter low of 35°F to a summer high of 80 to 90°F. One of the water-soluble chemical fertilizers, formulated for use on potted plants, should be added to the water once a week from January to October. Most citrus that I have grown bear fruit heavily every other year and sparsely in alternate years. Twelve to fourteen months elapse between flowering and the falling of the fully ripened fruit.

Chrysalidocarpus lutescens
ARECA PALM, BUTTERFLY PALM

This graceful, light green palm is widely grown as a potted plant in all parts of the world. Native to Madagascar, it is a true tropical and must not be subjected to temperatures below 55 degrees or it will die.

Palms are generally single-stemmed, like the Canary Island palm, date palm or the familiar Royal palm, or clump-forming like the Areca palm. I find the clump-forming varieties more attractive for pot culture. They grow like a clump of bamboo or grass with new shoots pushing up on the periphery of the clump. When the clump gets too big for the pot, it can be cut in pieces and replanted.

Coffea arabica COFFEE TREE

Coffee trees will grow in many living-rooms. While they are not naturally handsome, their leathery, green leaves and arching branches lend themselves to pruning and some shaping. They are definitely not shade plants, but I have seen fine specimens growing indoors near windows which do not face east or south. If they receive three or four hours of sun a day in the winter and spring, they should bear waxy, white flowers which become true coffee berries. Those that get less light in winter flower in the summer if they are put outside. Actively growing plants should be fertilized every two weeks with a water-soluble fertilizer.

Coffee in tree size is rarely seen for sale, but seedlings and small plants grow fast and may easily reach four feet in as many years.

Dracaena marginata DRACENA

If you like a lush, ferny mid-Victorian look in your house trees, you won't like this plant. Its bare, angular stems terminating in tufts of narrow grey-green leaves edged in purple give it a dramatic, modern effect. Very good winter light, preferably sun, and night temperatures no lower than 60°F are essential. Since growth is slow in winter, spring and summer fertilization is enough.

Ficus FIG, RUBBER TREE

This genus contains at least three species suitable for house trees in poorly lit corners. They will all withstand considerable fluctuations in temperature and irregular watering. In winter, when they are in a state of suspended animation, they should be watered thoroughly about once a week and never fertilized. When they are outside in the summer, they need large quantities of water and fertilizer and some filtered sun, or bright north light. Late summer is the time to expect new leaves and branches.

Ficus lyrata is a large masculine type of plant with enormous fiddle-shaped leaves; *F. elastica* is the well-known rubber-plant. Both make handsome trees. *F. retusa nitida* is quite different from the first two mentioned. The leaves are small, about the size and shape of mountain-laurel. Culture is the same as for the large-leaved species.

Grevillea robusta Silk-oak

The silk-oak, which is not really an oak at all, but a member of the tropical Protea Family, is a feathery, fast growing tree—an excellent selection for any sunny location indoors. The airy foliage does not block light from the rest of the room, and the stems and branches can be cut or bent with wire to make the tree assume any desired shape. Once this tree has reached the desired height, prune and cut it as much as you want. Dormant buds will readily develop into new leaves and branches to replace those that turn yellow and fall or are trimmed off. As long as there is new growth, do not be alarmed if some of the old is lost. Each leaf lives about one year.

Fertilize silk-oaks every two weeks or so from January to October, water them as often as the soil gets dry, and be sure that the container used drains easily and quickly.

Howea forsterana Kentia palm

If you want a care-free tree, this is it. Like most palms, it is durable and insect resistant, not set back by high or low temperatures, will grow in sun or in poor light, and can be left quite dry for days at a time. While it is often planted three, four or five to a pot, I prefer it with its natural single trunk. Mature plants are very handsome with their straight, smooth trunks holding up an arching canopy of dark green fronds.

Podocarpus gracilior Weeping podocarpus, African fern pine

The narrow, gray-green leaves of this tropical tree are soft and fragile compared to the more commonly grown plant of the same genus; nevertheless, it seems very house-hardy. Each fall or winter, there will be a massive leaf drop—at least half; all the older ones, not those on the branch tips. This is no cause for alarm and would, of course, happen if the tree were growing on the plains of its native East Africa. When the days become longer, new growth will start and the tree will fill out, probably needing pruning by summer.

P. macrophyllus maki Buddhist pine

This podocarpus has small, dark green leaves and is a slow-growing, trouble-free indoor tree. Most of the large plants sold in the North have been grown outdoors in Florida or Southern California. Growers often put two or three tall, skinny plants in one container to give a bushy effect. A single specimen is much more decorative. When you buy, look for a tree with a good trunk that can stand alone. To keep it looking full and compact, prune two or three inches off the ends of all the branches once each spring.

If your indoor location is bright and sunny, fertilize podocarpus monthly from February to September. If the location is near a north window or receives only comparatively little light, wait until summer to fertilize.

Rhapis excelsa Lady palm

The graceful, clump-forming lady palm from Southern China is one of the best small house trees I know. It is quite different from the other two palms mentioned here, the difference being mainly in the slender, reedy stems, covered with dark brown fiber, and the short, fan-shaped leaves. Specimens often grow to five or six feet, but you probably will not be able to buy one more than three or four feet high. They grow slowly and need fertilizer only four or five times during spring and summer.

In winter, keep the lady palm in any well lighted place indoors. It will not be adversely affected by cold drafts, but avoid temperatures below 50° F. ❧

All photos: George Taloumis

Flying high with . . .

HOUSE PLANTS THAT SWING

George Taloumis

Lantanas, ivy geraniums, fuchsias, tuberous begonias and browallias are widely grown outdoor hanging basket plants that inspire gardeners to create similar effects indoors. In fact, one can have beautiful hanging plants in many situations by using types more tolerant of higher temperatures and lower light than outdoor selections.

Glance at windows in city apartments or suburban homes at night, when the lights are on, and you will see veritable hanging gardens of Babylon, often with ferns, spider plants, Swedish-ivy, hoyas, wandering jews and grape-ivy so thick that you can hardly peer inside. In some windows they act like curtains or screens, providing needed privacy.

This enthusiasm for hanging baskets has occurred to such an extent that it is no longer confined to homes. Business places, including banks, have succumbed to the trend, so it is hardly uncommon to see hanging container plants swinging just about everywhere, high above, at eye level, or just a few feet above the floor.

It did not take long for this trend to take hold, and the reasons are many. Swinging plants create a mood, imparting an aura of their own that is akin to mesmerization. Suspended high above, or wherever, they provide an altogether different feeling than those plants that sit firmly on windowsills, plant stands or tables. Up in the air, they take up hardly any space, so it is possible to enjoy more plants in a limited area.

In spite of their "aloofness," hanging plants indoors require the same care as other house plants, including basic needs of soil, moisture, light (many foliage plants require but little), feeding, pruning and pest and disease control. For best

Peperomia obtusifolia variegata (above) is rather slow growing and easily controlled in a hanging basket.

The deeply-felted iridescent purple-green leaves of purple-passion (*Gynura sarmentosa*) make it outstanding.

development place them in front of windows or where they will receive sufficient artificial illumination. To keep them well proportioned, turn them around every week or so. Keep a small stool or ladder handy to make it easier to water those beyond reach.

Make certain the containers are suspended from securely installed brackets, hooks, metal or wooden bars, or toggle bolts. Remember that large containers increase in weight when soil is wet, so rely on strong rope or chains to hold them firmly.

Many kinds of containers can be used. Pots can be clay or plastic; the latter has the advantage of staying moist longer. Copper, brass, aluminum and other metal types are handsome and durable, and often come equipped with chain straps or other means by which they can be suspended. Some are simple, others elaborate, with tassels and other embellishments. What you select is a matter of taste, but always keep background, proportion and color scheme in mind when making your selections.

When using the kinds of baskets in which pots are placed, always include saucers to catch drainage water. Many hanging containers come equipped with saucers attached at the bottoms. On the other hand, it is possible to grow healthy plants in containers with no drainage openings, such as glass receptacles through which root systems show or strawberry jars, but in these instances watering must be administered carefully. As with the Japanese dish gardens, it can be done successfully if one understands watering procedures.

As for soil, a general house plant mixture will suit most kinds, except for ferns and gesneriads which need a higher humus content. These will flourish in a mix of two parts loam (use packaged house plant soil which is pasteurized), one part peat moss, leafmold or compost, and one part sand, perlite or vermiculite. To this sprinkle a light scattering of bone meal and a mixed fertilizer.

Favorite Plants

There are several kinds of plants that are so easy that you will have no difficulty succeeding. One is the well known heart-leaved philodendron (*P. oxycardium*), a plant that survives with subdued light, infrequent watering and other aspects of neglect without wilting. Several others in the same Aroid Family qualify, including pothos, recommended because their heart-shaped leaves are blotched with creamy-white, and nephthytis and syngoniums, climbers that will trail.

Though the best candidates for hanging containers are plants that are pendulous by habit, the characteristic that is their charm, upright type plants can be selected. Much depends on the effects you want to achieve. The favorite Sprenger asparagus (*A. densiflorus* 'Sprengeri') arches and spills like a fountain, yet its first cousin, asparagus-fern (*A. setaceus*; synonym, *A. plumosus*) with its tiny leaves, is hardly to be ignored. Spathiphyllums, wax and other begonias, and bird's-nest snake plants

Compact growth in grape-ivy (*Cissus rhombifolia*) is encouraged by good light and pinching the growing tips.

(*Sansevieria* cultivars) are some other upright plants that can be grown in hanging containers.

In city apartments, where light can be poor, try creeping fig (*Ficus pumila, F. saggitata*), some of the many kinds of hoyas such as 'Pink Silver' or 'Silver Princess' and cultivars of English ivy (*Hedera helix*) such as 'Merion Beauty', 'Goldheart', 'Pedata' or 'Maple Queen'. Or try some of the *Cissus*, for example, grape-ivy (*C. rhombifolia*), kangaroo vine (*C. antarctica*), or *C. adenopoda* with velvety, three-parted leaves.

Wandering jews and inch plants (tradescantias) are good just about anywhere, and they will grow in shade. And they can even be grown in water. As plants become straggly they can be replaced by young specimens rooted previously in water or a mixture of peat moss and sand. Maroon and silvery-striped *Tradescantia zebrina* is one of the best, and its coloring is more intense if it is grown in sun. But try the giant white inch plant (*T. albiflora*) or the flowering inch plant (*T. blossfeldiana*), with waxy light green leaves, purplish on the undersides.

There is yet another trailer that has enjoyed enormous popularity, and that is purple heart (*Setcreasea pallida* 'Purple Heart', also sold as *S. purpurea*). It has leaves that are green above and intensely purple on the undersides, more so if plants are grown in sun, where they perform best.

Other Candidates

There is no reason why you cannot enjoy small-sized hanging plants, particularly when windows are small and space is limited. Among compact types of African-violets I am fond of 'Sally', a violet-blue, and 'Ann', a pink. Branch out, however, to some of the drooping gesneriad relatives such as columneas, hypocyrtas and several episcias, including 'Chocolate Soldier', 'Silver Sheen' and 'Emerald Queen'. Episcias are plants that do best in diffused light and a soil that is fluffy and well drained.

For delicacy and grace, what can surpass ferns? The Boston fern (*Nephrolepis exaltata* 'Bostoniensis') is an oldtime, but

A combination of hanging and windowsill plants, for greenery and a street-screen, include English ivy, hoya, spider-plant, African-violet, peperomia and snake plant. Many of those in pots would look as well or better in a hanging basket.

a perennial favorite. As with all ferns keep it out of strong sun, or its fronds will turn yellowish. It can, however, be placed in a sunny window if shades, Venetian blinds, draperies or curtains are drawn when the sun is shining. A compact variation is 'Fluffy Ruffles', with leaves that are more finely cut. Rabbit's foot fern (*Davallia fejeensis*) takes well to a hanging container, without seeming to mind hot, dry air too much. Smaller is the ethereal button fern (*Pellaea rotundifolia*), with little, rounded leaflets, hardly resembling a fern.

Try queen's tears (*Billbergia nutans*), a bromeliad that is easily recognized by its slender, arching, grasslike leaves that curve gracefully. On mature plants you will be rewarded with clusters of drooping flowers that are comprised of reddish-pink bracts with green and purple flowers, well supplied with yellow stamens.

When it comes to hanging baskets indoors, be imaginative and experiment. Try Thanksgiving and Christmas cacti, pepper face (*Peperomia obtusifolia*) and prayer plants, including Voster's maranta (*M. leuconeura erythroneura*), with fishbone markings on its leaves. Proceed to *Coleus* 'Trailing Queen', string-of-buttons (*Crassula perforata*), *Pellionia* species (which are tolerant of deep shade), the old-fashioned pink-flowering oxalis (*O. rubra*), black-eyed-susan vine (*Thunbergia alata*), the white- and red-veined fittonias, rosary vine (*Ceropegia woodii*), ivy geranium 'Sugar Baby', and the pendent *Peperomia scandens*.

Want to be still more adventurous? Then the next time you purchase a shamrock from a florist at St. Patrick's Day, keep on growing and nurturing it, repotting, feeding and keeping it in full sun. In a large-size pot it will trail and fill out beautifully to become the hanging container plant that is your pride and joy. If it's the hop or yellow clover (*Trifolium agrarium*), you will be rewarded not only with rounded yellow flowers, but also the pleasure of answering those who see it and invariably ask: "What is that delightful plant?" ☘

For variety grow some . . .

UNUSUAL TROPICALS

Michael J. Kartuz

Many charming tropical house plants do not fit neatly under other headings in this Handbook but nonetheless are deserving of your attention. Here are some of my favorites, with suggestions on how to grow them well.

Abutilons, which are sometimes called flowering-maples, are shrubby plants with soft, maplelike leaves and nodding bell-shaped flowers in shades of red, yellow and white. They bloom most of the year when given strong light and cool night temperatures. A standard potting mix with good drainage is satisfactory. Allow abutilons to dry out slightly between watering. Severe pruning is recommended once or twice a year, as abutilons are rapid growers and flower on new wood. Give light, frequent feeding when plants are in active growth.

Acalyphas, shrubby members of the Euphorbia Family, are grown for their showy, tassellike flower clusters or their colorful variegated foliage. Stems are woody and upright. Leaves are oval, serrated and often deeply ruffled. Strong light and a minimum of sixty percent relative humidity produce the best acalypha. Pot the plants in a well drained mix and water when slightly dry. Prune regularly, at least twice a year, to keep plants shapely.

Chenille plant (*Acalypha hispida*) has attractive pendent spikes of red or pink flowers. *A. wilkesiana* has glossy leaves of copper splashed with rust, bronze and green.

Clerodendrum (*C. thomsoniae*) is a vining plant with dark green, oval leaves and clusters of conspicuous white calyces, turning pink with age, surrounding small red flowers. Clerodendrum has high light requirements; it needs at least several hours of sun per day. Moderate humidity should be maintained. Frequent pruning will keep this plant shapely. Severe pruning in late winter will encourage a good show of flowers in spring.

Bougainvilleas are shrubby or vining plants with clusters of brightly colored, papery bracts. Grow bougainvilleas in your sunniest window—they need very bright light. Provide a well drained, humusy soil. Allow plants to become quite dry between watering.

Prune bougainvilleas hard after flowering, particularly in the fall. Flowers are produced on new growth. Plants may occasionally drop all their leaves. Do not be alarmed; water very sparingly until new growth commences. Bougainvilleas are excellent subjects for bonsai.

Serissa (*S. foetida*) is a small, shrubby plant with tiny oval leaves and dainty white flowers, produced freely during winter and spring. *S. foetida* 'Variegata' has leaves edged creamy white. 'Flore-pleno' has small double white flowers. Keep plants evenly moist. Provide a humusy potting mix with good drainage. Serissas are particularly attractive subjects for miniature bonsai. Light requirements are moderate to high, with good humidity.

False-heather (*Cuphea hyssopifolia*) is a dwarf, shrubby plant, with tiny leaves and small, light purple to deep rose flowers produced all year. The plant needs moderate to bright light. Provide a minimum humidity of fifty percent. Pot in a well-drained potting mix but do not allow *Cuphea* to dry out at any time.

Miniature pomegranate (*Punica granatum* 'Nana') is a slow growing, shrubby plant with small, light green leaves and large, crinkly, bright red flowers, followed by long lasting, attractive fruit. Keep *Punica* evenly moist. Use a well drained, humusy soil. Repot at least once a year, preferably in spring. Prune judiciously to keep it shapely. Grow in moderate to high light. *Punica* is a good subject for bonsai.

Oxalis are a varied group of plants that can be immediately recognized by their trifoliate, cloverlike leaves. Some oxalis are fibrous-rooted, while others

Hoya carnosa, in the form called Hindu rope, has twisted waxy succulent leaves of green and cream, often shot with pink when grown in bright light. Stems will trail or can be trained on a support.

form underground bulbs or corms.

O. corymbosa 'Aureo-reticulata' (*O. martiana*) has an abundance of attractive yellow-veined leaves. Rose-pink flowers are produced periodically through the year. Moderate to high light is needed. A well drained soil is preferred. If plant begins to look untidy, cut it to the ground and let new leaves form.

O. regnellii has white flowers produced in profusion all year, even under adverse conditions. Leaves are dark green, deltoid-shaped. Cut back to ground when plant looks untidy.

O. hedysaroides 'Rubra' has deep, ruby-red, fern-like foliage. Small, bright yellow flowers are produced throughout the year. Stems are short, wiry and upright. Use a well drained, humusy soil. Keep this oxalis moist at all times. Light requirement is high, with moderate humidity.

Hoyas are vining plants with thick, leathery leaves. Clusters of waxy, star-shaped intensely fragrant flowers are produced several times a year on many species. Hoyas prefer a very sunny location for flowering, but some kinds tolerate low light. Blossoms are produced on spurs in the leaf axils. Spurs elongate, producing flowers for many years on most species so do not cut off.

Hoyas tolerate considerable dryness but prefer a certain amount of humidity when in flower. A well drained, humusy soil is fine. Allow soil to become quite dry between watering. Just an occasional fertilizing is necessary, and only for actively growing plants.

Hoya carnosa and its many variants are most commonly seen and are of easy culture. *H. bella* is a dwarf grower with closely set, small, pointed leaves, and spreading, pendent stems. The pink centered, white flowers are deliciously fragrant. *H. australis* has light green oval, almost round leaves and clusters of chocolate scented white flowers. *H. lacunosa* is a miniature which needs less light and space than *H. carnosa* types.

Peperomias are a large group of succulent-leaved plants grown primarily for their varied and interesting foliage. Most have moderate light requirements and tolerate fairly low humidity. Some of the rarer types need more humidity and are good terrarium subjects. All prefer a well drained, humusy soil. Do not keep the soil too wet. Fertilize very sparingly.

Tetranema roseum (*Allophyton mexicanum*) and the white cultivar 'Purity' are

Oxalis hedysaroides 'Rubra' contrasts deep ruby red leaves with intense yellow flowers. Rich, well drained, moist soil and good light assure best performance.

virtually everblooming tropicals with clusters of half-inch rosy purple or white flowers on short, upright stems. The smooth, narrow, oval-shaped, dark green leaves are closely set on very short stems.

Tetranema requires moderate to high light levels with a fair amount of humidity. A humusy soil with good drainage is recommended; keep the soil moderately moist at all times. ❦

The Mexican foxglove (*Allophyton mexicanum*) will produce rosy-purple blooms all year on established plants.

All photos: Charles Marden Fitch

Not as difficult
as some people think . . .

GROWING ORCHIDS IN THE HOME

Thomas Powell

There is a saying, "If you can grow African-violets, you can grow orchids." Some enthusiasts would go so far as to say that success with almost any house plant augurs success with orchids!

As thousands of indoor gardeners have discovered, orchids are neither fragile nor difficult. Indeed, one of the most interesting things about these beautiful plants is that they seem able to accommodate themselves, within reason, to widely varying cultural practices and environments.

A great many orchids will thrive on a windowsill, provided their three most important needs are met: light, temperature, and humidity.

Light. The epiphytic (air-growing) orchids like lots of light, but it must not be constantly direct and hot. A south or perhaps an east or west window, with the sunlight filtered through a thin curtain, is excellent. On dull days and in winter, the curtain can be removed. At all seasons, an abundance of morning and late afternoon sun produces the best growth.

Some terrestrial or soil-growing orchids, such as the lady-slippers (*Paphiopedilum*), thrive without any direct sunlight. They will do well placed farther back from the window or on the side where the sun's rays do not strike.

Temperature. Normal daytime temperatures in the home are fine for orchids.

Honey-scented *Epidendrum tampense* (opposite) from southern Florida is easy to grow in a bright location. The swan orchid (*Cycnoches ventricosum* var. *warscewiczii*) (right) has a yellow flower with white lip and green platform. Heavily fragrant.

All photos: Charles Marden Fitch

Most genera prefer a minimum night temperature between 55 and 60°F, which is easy to attain in most homes. But remember that it is usually quite a bit cooler near the window in winter than it is out in the room, so it's a good idea to check with a thermometer. Move the plants back from the glass if necessary, or, better yet, tack or tape a clear plastic sheet over the window to act as an insulator.

Humidity. Ample moisture in the air is vital. Luckily, the required fifty to seventy percent humidity is not hard to supply even in modern heated homes. You can mist-spray your plants daily with one of the atomizers available in garden supply stores.

Or, even easier, grow your plants on a tray in which an inch or two of pebbles supports the pots above water. Galvanized trays made by a tinsmith are fine, or you can make your own of the inexpensive sheet aluminum sold in hardware stores. A wooden tray may be lined with a plastic sheet to make it watertight. Some growers also hang a plastic sheet across the entire window area to form a sort of enclosed greenhouse.

Another solution is the miniature greenhouse or Wardian case. An enclosed case makes it simple to maintain the proper temperature and humidity. A number of these are on the market, or you can build your own. A tray for holding pebbles and water, plus glass walls and a glass roof, gives you a basic Wardian case. Refinements such as a thermostatically-controlled heating element and even fluorescent lights may be added.

However, be sure to provide for ventilation, as the atmosphere in an enclosed case is apt to become stuffy and overmoist. Orchids need fresh air to prevent rotting and other fungal diseases. Sliding doors or a hinged roof are necessary on Wardian cases, and for all home-grown orchids it's wise to occasionally open a distant window a crack even in freezing weather, to provide a change of air.

Best Kinds to Grow Indoors

Now, how do you start your orchid collection? Experienced home growers suggest that you begin with mature, blooming-size plants of a popular genus such as *Cattleya*, the big showy corsage orchid. Later, when both your enthusiasm and experience have grown, very likely you will want to expand to other genera and to raising seedlings or even sowing your own seed.

Cattleya species recommended for beginners are *C. mossiae*, *C. gaskelliana*, *C. labiata*, *C. percivalliana*, and *C. trianaei*. There are many others, of course, as well as thousands of hybrids that often boast more gorgeous blooms and greater vigor. The commercial grower from whom you buy your plants will be glad to suggest plants for a succession of bloom throughout the year.

Incidentally, contrary to popular belief, orchid plants are not expensive. While

Three orchids (clockwise from top left, *Cycnoches* 'Cygnet', *Angraecum* 'Ol Tukai', and *Cattleya loddiaca*) thrive under intermediate temperatures with bright diffuse light.

some extremely rare ones, or a few exceptional breeding plants, may bring fabulous prices, you can buy many good species and hybrids for from $10 to $20. Often their first blooming will give you flowers worth at retail as much as the plants cost.

Three other genera are especially well suited to home growing. *Laelias,* with starry-shaped flowers in many hues, are often found in their native habitat growing in windswept places where the days are hot and nights cool. Thus they are tolerant of the drastic changes in temperature and drafts encountered in the home. *Laelia anceps, L. autumnalis,* and *L. rubescens* are good choices.

Oncidium is a genus of many species with delightful white or yellow flowers marked with brown and red. Some are miniature plants, others bear flower sprays several feet long. *O. cheirophorum* is a fragrant yellow-flowered miniature. *O. ornithorhynchum* bears dainty sprays of fragrant rose-purple blooms. *O. papilio,* the bright and unusual "butterfly orchid," often blooms almost all year long. *O. splendidum* produces heavy sprays of comparatively large flowers.

Epidendrums, too, come in all shapes and sizes and are very tolerant plants. One of the best is *Epidendrum tampense,* a native of Florida, which bears numerous short spikes of chartreuse blooms in spring.

You will soon want to get some of the dependable home bloomers, such as *Paphiopedilum maudiae,* the waxy green and white lady-slipper orchid. *Brassavola nodosa,* the white "lady of the night," is very fragrant after dark, and is one of the easiest to grow. *Cycnoches chlorochilon* has large fragrant swan-shaped flowers. *Phalaenopsis,* the "moth orchids," are suitable under lights or in diffused sun.

These are only a few of the popular orchids amenable to home culture. Dozens of other genera—*Miltonia, Catasetum, Lockhartia, Maxillaria* and others—have proven their worth. Since there are approximately thirty thousand species of orchids, plus countless hybrids, you have ample to choose from! Today multigeneric hybridizing is producing some spectacular plants that are wonderfully easy to grow. Crosses of *Epidendrum* x *Cattleya, Ascocentrum* x *Vanda,* and *Sophronitis* x *Laelia* x *Cattleya* are some of these marvels of the plant breeders' art.

Water Requirements

All these beautiful plants, surprisingly, require less routine maintenance than many common house plants. Watering is the most important concern. Too-frequent watering is the most common cause of failure with orchids.

Epiphytic orchids are potted in mixtures of tree fern, fir or redwood bark, plus perlite. Some growers prefer to use plain osmunda. Whatever the mixture, it must drain quickly.

Brassavola 'Jiminy Cricket' has compact growth, night-fragrant blooms.

The osmunda (fern root) potting medium should be slightly moist—never soaking wet—while the plant is actively growing and when it is producing flowers. This may mean watering only twice a week or even less frequently. Keep the medium somewhat drier during resting or dormant periods. Plants potted in the tree bark medium will need watering more often, as bark is less water retentive.

While each grower must work out his own watering schedule, a good general rule is to err on the dry side rather than the wet. Only terrestrial orchids such as *Calanthe, Phaius, Cymbidium* and *Paphiopedilum*, all planted in rich soil, like to be kept constantly damp, but never soggy, at the roots.

Fertilizers

Monthly feedings of fish emulsion fertilizer supply ample food for orchids potted in osmunda. Those in bark, however, should be fed a high-analysis fertilizer with every second watering. Most growers use a 30-10-10 formula during the season of growth, switching over to a 20-20-20 formula when bloom time approaches. Repotting is usually done every two years, after flowering.

An outdoor vacation in summer will help plants grow sturdy and increase the quality and quantity of blooms. Put them on benches under an open tree—or hang them in the branches—where they will get filtered sunlight at mid-day, direct sun in early morning and late afternoon.

Recently, amateurs have reported considerable success growing orchids under artificial light. High intensities and balanced light are needed. Combinations of equal numbers of 40-watt standard cool white and deluxe warm white fluorescents, or of 40-watt broad-spectrum fluorescents in fixtures with at least two tubes each are satisfactory. Plants should be as close to the lights as possible without risking burning the leaves. The lights are kept on about fourteen hours a day.

You can get lots of information from orchid books and growers, but the plants themselves will be your best teachers. A high degree of success depends upon observation, experimentation, and above all, patience. Some plants will acclimate themselves and grow and bloom dependably from the day you bring them home, while others may have to be moved around several times in your growing area until just the right conditions are found for them. Growing orchids in the home is a challenge, giving perhaps the greatest rewards of any indoor gardening project.

To receive a free detailed orchid culture booklet and the monthly color illustrated *A.O.S. Bulletin*, you can join the American Orchid Society. Write to American Orchid Society, Botanical Museum of Harvard University, Cambridge, MA. 02138. ☙

Roche

THE CULTURAL NEEDS OF CACTI

Henry Teuscher

Cacti make excellent house plants, provided one realizes that they are sun-loving plants and treats them accordingly. Actually, their whole lives are governed by light to such an extent that the amount of light they receive determines how much heat and moisture they can utilize or tolerate.

This means that in summer when cacti are growing and should be exposed to full sunlight, they can stand any amount of heat. During this period they will benefit also from ample, twice-weekly watering.

During winter, when the available light indoors—even on the windowsill—is always poor, cacti should be kept cool, to maintain the balance between heat and light. From November to February or March a light watering once a month is enough. A temperature of 45 or 50°F is most satisfactory during this period. Cacti then go to rest while the small amount of water supplied prevents their shrivelling and saves their roots from dying. Actually, this rest is required to make them flower in spring.

Many amateurs make the mistake of assuming that since cacti are desert plants, they want to be hot at all times, not realizing that winter nights can be bitterly cold on most cactus deserts. The windowsill, directly over a hot radiator, is

Opposite, a typical bloom of orchid cactus (*Epiphyllum*). Flowers are three to ten inches across.

certainly the worst place for a cactus plant in winter. One solution is to place cacti on glass shelves, suspended from above, directly against the window pane, with the radiator beneath them shut off. This is quite satisfactory as long as the overall room temperature is not allowed to rise above 65 or 68°F. An excellent place for storing cacti over winter is an unheated attic which is free of frost. When at rest and kept rather dry, cacti require little light and most will then tolerate without harm a temperature of 40°F.

Drainage

With few exceptions, which are of no interest to the amateur, cacti cannot live in stagnant moisture, and for this reason cactus soil must be composed in such a manner that it provides ample drainage as will be detailed below. For the same reason it is advisable to place a two-inch layer of gravel or crushed limestone under the pots of cacti which are sunk in the soil outdoors during summer. The pots themselves should be surrounded with sand. This precaution is, of course, most important when the garden soil is clayey and does not drain well by itself.

Danger of Sunburn

When placing cacti outdoors in spring, one should remember furthermore that, after having spent the winter indoors, their tissues are quite tender, and that immediate exposure to the full force of the sun is likely to cause sunburn. To avoid injury, it is necessary to accustom the plants gradually to the sun, and for the first week or ten days the cacti should be shaded during sunny noon hours, so that they receive sun only in the morning and the late afternoon.

Transplanting

Cacti in nature spread their roots for many yards. When confined in pots, they exhaust the soil within two years, and, if not transplanted every two years, their roots commence to die. If in that state a cactus plant is watered freely, it rots. If it is not watered—cacti should not be watered when they are not growing—it gradually shrinks in size and eventually it is likely to topple over, having no roots at

Ferocactus latispinus (top) has spines, one of which curves like a bird's beak; below, two mammillarias and (center) a wigginsia show long-spined, squat-spined and heavy-spined examples of cultivated cacti.

M. Joyner

all. To save such a plant, it has to be transplanted, because it will never make roots again in the same soil. In addition, it must now be treated as a sick patient.

The fresh soil must be left dry, and the cactus should be placed in a scooped out hollow filled with sand so that it does not touch the soil. To prevent it from moving, it may be held down tightly with two strings crossed over its top which are tied under the bottom of the pot. After three or four days the sand should gradually be moistened a little by allowing a few drops of water to trickle down along the cactus plant. This should be repeated every three or four days. If this is done properly, the cactus will gradually become plump again, and, when its crest shows signs of life by changing color, we are assured that it is producing new roots. The soil then should be drawn over the sand and the plant should gradually be watered more freely.

In this manner it is possible to save a cactus which would otherwise be lost, but the scars caused by such an enforced dormancy remain for its whole lifetime, and it will never be a perfect specimen. Therefore, if one wants to grow a fine specimen, one should not wait until the plant is in distress but should transplant it every two years, even when a larger pot is not required.

Soil Mixture

The best time to transplant cacti is in early spring, March or April, as the various types and varieties show signs then of returning activity after their winter rest. A suitable soil mixture consists of the following ingredients:

3 parts good garden soil (preferably a clay-loam)
1 part well decayed leafmold
½ part sharp sand (builder's sand)
½ part crushed limestone (¼″ size)
½ part crushed brick

To this should be added a small amount of powdered limestone as well as some tobacco dust. Of each of these two ingredients only a "pinch" per pot is needed (as much as can be taken up with the finger tips), or a 2½-inch flower potful to a bushel of soil. The same amount of fritted trace elements may also be added, but no other fertilizer should be incorporated.

Peat moss should not be used. Leafmold, of which only small quantities are needed, may be gathered during summer in the woods. Crushed brick, which has the valuable ability to hold a certain amount of water while allowing surplus water to drain away, may be prepared by smashing broken pieces of brick with a hammer into pea-size fragments. The brick dust should be sifted out. Dried and powered cigarette or pipe tobacco may be substituted for tobacco dust. It serves as a very mild fertilizer and at the same time it acts as an effective preventive against root lice which frequently infest the roots of cacti.

Growing cacti which occupy their pots

Most cacti respond well to a sunny window provided it is not below freezing on winter nights.

Paul E. Genereux

Roche

Christmas cacti, like many orchids, are epiphytes (tree dwellers), hence their needs are more conventional than are those of most cacti. With proper care they are long-lived, reliable bloomers.

for the second year may be fed with a mild solution of a complete fertilizer, such as Hyponex, at the rate of one teaspoonful to a gallon of water once a month.

Christmas and Orchid Cacti

These handsome cacti are not desert dwellers but usually grow on the branches of trees or in cracks of rocks where humus has accumulated. In consequence, they require a somewhat richer and looser soil. The amount of leafmold given in the above recipe should be increased to two parts. The crushed limestone should be left out. Powdered limestone and tobacco dust should be replaced by dehydrated sheep manure and bone meal in approximately the same amounts. Christmas and orchid cacti should never be exposed to the full sun but, if placed outdoors during summer, should be kept in partial shade.

When these two types of cacti are brought indoors in fall, it is advisable to syringe their leaves several times a week. One may also prepare for them large, pebble-filled saucers in which water should be kept, placing the pots on top of the pebbles but not touching the water. This will serve to humidify the air around the plants which will assist them materially in developing their flowers. The change from the fairly humid outdoor air to the dry air of a heated room frequently causes dropping of the flower buds, if no such precautions are taken. The rest period is much less pronounced with these South American cacti.

Propagation

Offsets, or shoots formed at the base, or side branches of a cactus, may be used as cuttings after their seasonal growth is completed. They are then severed with a sharp knife from the parent plant at their very bottom. With some cacti, "pups" even break off easily when the plants are at rest. Such cuttings are then treated in a manner very similar to that described for a cactus which has lost its roots. Cut ends are dipped in powdered charcoal to prevent rotting, and the cuttings are inserted in dry sand to which a small amount of soil may be added. For the first two or three weeks the sand is kept dry, after which it is moderately moistened from time to time. When the cuttings show signs of growth at their tips, they are watered more freely until they are ready for potting. A foot-long piece from the top of a tall column cactus can be treated in the same manner, though the cut end must first be allowed to dry for three or four weeks. ⁂

A nearly infinite diversity with . . .

SUCCULENTS INDOORS

Charles Glass and Robert Foster

Contrary to popular belief, succulents are *not* ideal house plants. Yes, they generally come from dry areas and need infrequent watering, but they are mostly sun-lovers which thrive in fresh air. This does not mean that they cannot effectively be used as house plants and, given reasonable care, thrive.

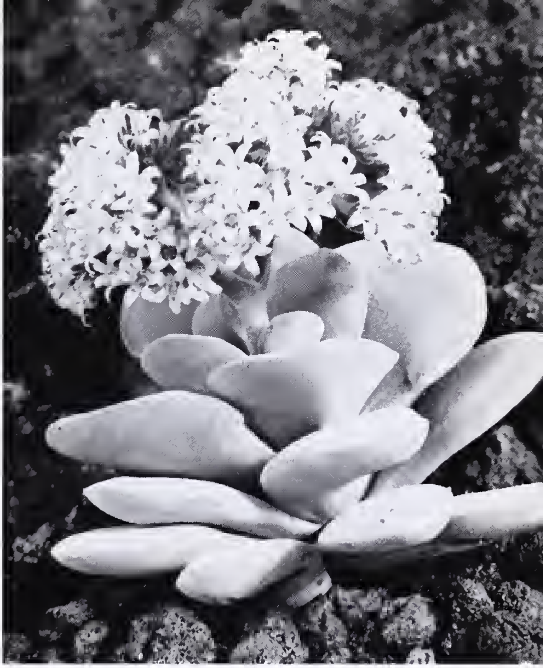
Culture

Succulent plants grown indoors need as much light as can be provided. They should not be placed so close to a windowpane that they will scorch in the sun's direct rays (or freeze at night), but be located in as bright and sunny a spot as possible. The ideal situation is where a greenhouse or out-of-doors, frost-free, bright location is available and the plants can be rotated, with no particular plant being kept indoors for too long a period. The length of this period can be determined by the plant's responses: if the plant becomes pale and starts to produce weak, spindly growth it is time to take it to your "hospital." At the same time, a plant which has been growing indoors should not be taken out and subjected immediately to direct sunlight to which it has become unaccustomed, but placed in a lightly shaded spot and gradually nursed back to health.

If such facilities are not available, one must endeavor to inhibit the overly-lush growth that indoor culture will encourage. For succulent plants grown under ideal conditions, we recommend a loose but rich, fast-draining potting mix and thorough but infrequent waterings. Feedings should be dilute but frequent. Indoors, the potting mix will tend to stay damp longer, so waterings should be less frequent, and if the soil is still moist the plant should not be watered until it has started to dry out. Feeding of plants grown only indoors is a risky business, as one should not attempt to encourage lush growth, which under the available light conditions would be weak and abnormal. Growing succulents under lights indoors has proved quite satisfactory, so if such an arrangement is possible, you will have a far greater chance of success.

To keep one's indoor succulents as healthy and normal as possible, one must know how a healthy, normal plant should

Aloe descoingsii is a marvelous dwarf member of this succulent genus of the Lily Family, with red flowers on a slender stalk, and rosettes of leaves only a few inches in diameter.



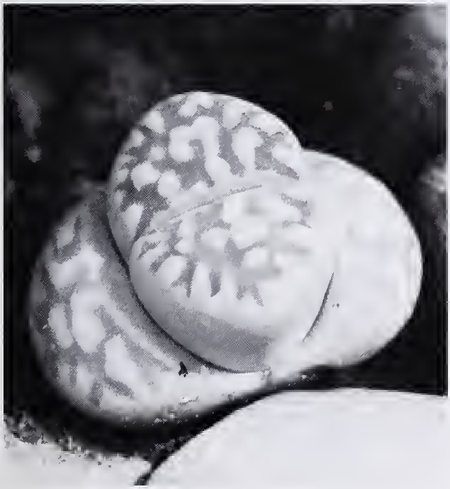
Crassula 'Morgan's Beauty', a fine hybrid with grayish-blue, felted leaves, arranged like the wings of a butterfly, and compact heads of pink flowers.

look. Presumably, the plant when acquired would be in a near-ideal state, in which case the goal would be simply to maintain this appearance. However, this is not always the case, particularly if the plant has been obtained from a mail-order nursery and been too long in transit, or too long in a florist shop or supermarket. In general, succulent plants should have a fairly compact, uniform appearance. Too often, even in books promoting succulents as house plants, one sees abnormal, spindly, pin-headed, attenuated, bleached-out growth, which may make the grower believe the plants are thriving, whereas all they are doing is stretching to their utmost to obtain enough light to survive!

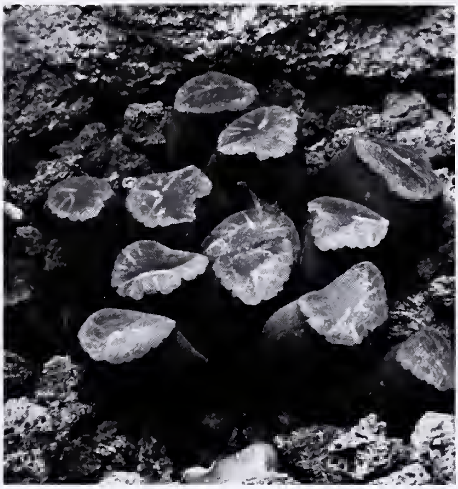
By this point we have possibly discouraged you from even attempting to grow succulents indoors! Let us hope not, for succulents can provide an enormous amount of interest, enjoyment and decoration in their nearly infinite diversity. For centuries they have been grown indoors nearly all over the world with considerable success.

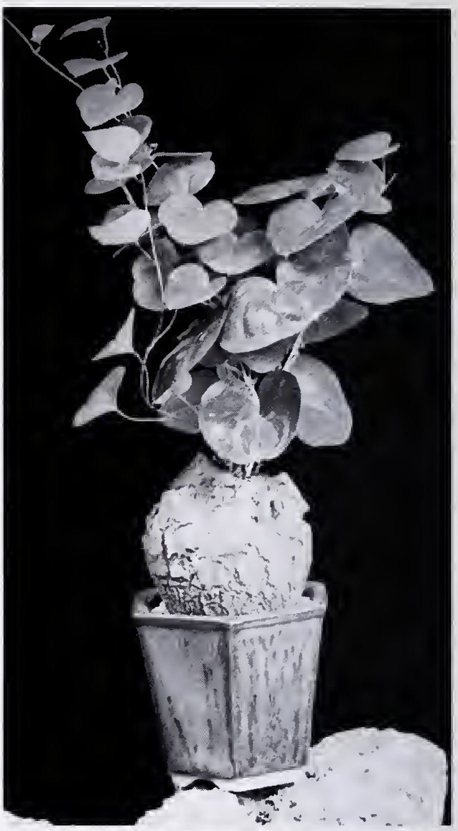
For better culture of succulent plants one should consider the nature of succulence. Succulence is the ability of a plant to store moisture in its tissues—its leaves, stems or roots—to survive prolonged periods of drought. This character is not unique but an exaggeration of a characteristic present to some degree in nearly all plants. Succulence does, indeed, occur in a great number of plant families. The Cactus Family is one where nearly all members exhibit a pronounced degree of succulence. Many African members of the large genus *Euphorbia* of the Spurge Family are succulent, and quite similar in appearance to the cacti of the Americas. The Ice-plant and Stonecrop families provide us with some of our most fascinating succulents, and many

Photos: Author

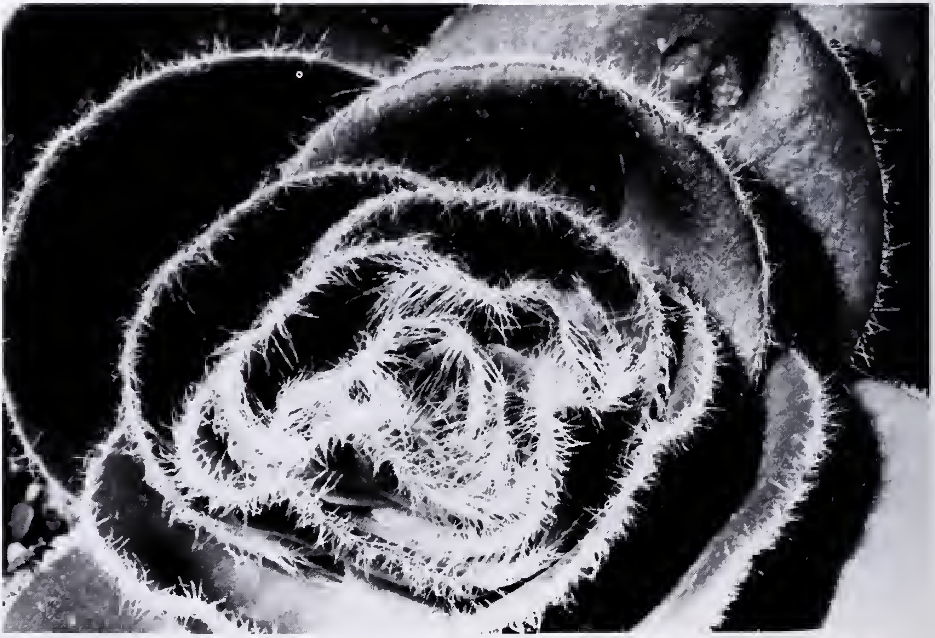


Any species of *Lithops* is virtually irresistible. Lithops are mimicry plants that resemble pebbles, scarcely an inch in diameter, consisting of 1 or 2 pairs of leaves. Annually a bright yellow or white flower appears from between the two central leaves. These plants will never outgrow your tiny pot or your windowsill.





Above, *Haworthia maughanii,* a remarkable species with truncated leaftips and clear (windowed) membranes. Right, *Testudinaria* (*Dioscorea*) *elephantipes* is a fascinating succulent with its corky succulent base and leafy, vine-like stems. "Elephantipes" means "elephant's foot." Below, *Crassula barbata,* a charming rosette succulent with green leaves "bearded" with soft white hairs. Remarkably drought-resistant, it should be grown "hard" and compact by being stingy with water.



members of the Lily, Daisy and Milkweed families are succulent.

Some Desirable Kinds

Among the most suitable succulents for indoor culture are the sansevierias of the Lily or Agave Family (botanists disagree on their placement). These plants seem virtually indestructible, which explains their dusty, forlorn look in so many neglected planters throughout the world. But because one simply takes them for granted, especially the common snake plant (*Sansevieria trifasciata*), they do not deserve dismissal and, indeed, with new appreciation for their durability, diversity of form and elegance of appearance, many are coming back into favor. Among the more interesting are *S. arborescens,* a pale green species with a stem up to three or four feet tall, and spiralled leaves, projecting out horizontally, over a foot long, stiff and quite pungent at the tip; *S. ehrenbergii* with channeled, white-edged leaves; *S. grandis* with marbled leaves nearly a foot long and up to half as wide; *S. metallica* with striking purplish gray, mottled leaves; and *S. singularis* which in its mature form has only one thick, rounded, erect leaf per head.

In the Lily Family, which includes far more than the lily of gardens (*Lilium*), there are many good succulents, particularly in the genera *Aloe, Haworthia* and *Gasteria*. Most aloes soon grow too large and ungainly for reasonable pot-culture, but some of the so-called dwarf species make fine house plants. They include *Aloe rauhii* with its clustering rosettes, about four inches in diameter, of spotted, pale bluish-to-reddish leaves; *A. variegata,* the partridge-breast aloe, with its erect, triangularly arranged, green and white striped leaves; *A. jucunda,* with small rosettes about 3½ inches in diameter of dark green, spotted leaves with small reddish brown teeth along the margins; *A. haworthioides* which looks like a delicate, lacy haworthia; and the rare, tiny *A. descoingsii.*

The genus *Haworthia* offers a number of connoisseur's succulents. Anyone would be charmed by plants of *H. truncata* or *H. maughanii* with windowed leaves that seem to have been cut off at the tips with a knife, or by the lacy beauty of *H. bolusii* or *H. setata* and their varieties. Also, virtually any gasteria is to be recommended, particularly the tiny *Gasteria liliputana* or the handsome *G. batesiana* with its sandpaperlike leaves.

There are some very choice dwarf euphorbias, most of which come from Madagascar, that make delightful pot-plants, such as the miniature shrubs of the *Euphorbia decaryi-francoisii-cylindrifolia* complex. *E. milii* var. *imperatae* is a tiny crown-of-thorns type, barely a foot tall at full size, with charming, bright red flowers. An old standby is the golf-ball-sized *E. obesa,* the plant reduced to a marvelous round ball without spines, leaves or branches.

There are many mimicry succulents which are almost irresistible, such as *Lithops* species of the Ice-plant Family which look like brightly colored pebbles, or the *Pleiospilos* species which look like hunks of brownish rock which have been split in half (until the large yellow-to-orange flower appears in the middle!).

Echeverias, though very similar to one another in their rosette appearance, offer a subtlety of pastel colors that have won them a permanent place with collectors. *E. shaviana* with its ruffled pink-to-bluish leaves is a jewel, as are *E. setata, E. ciliata, E. pulvinata* or the more difficult-to-grow *E. leucotricha,* their leaves clothed with white hairs. *E. subrigida* and *E. peacockii* are stunning, their bluish leaves completely covered with a chalky white powder, but the best of this type is the recently discovered *E. laui,* which forms a rosette eight or more inches in diameter of rounded, chalky-white leaves.

Lists of desirable succulents could go on almost endlessly, but the best approach is to start with a few different types that appeal to you and experiment a bit. Try them in different locations, different potting mixes, different watering schedules. See which technique is best suited for your circumstances and which types of plants do best under your care, and then specialize in those groups. No guidelines or rules can compete with knowledge gained through experimentation and experience.

Amaryllis and other, less common . . .

TROPICAL BULBS FOR THE HOME

Don Richardson

The great beauty of tropical bulbs can and should be appreciated in the home. Yet many are purchased, then lost, because their cultural requirements are not well understood. Several factors should be considered when selecting tropical bulbs: size of the mature plant; flowering season; temperature and light requirements.

These factors are important for various reasons. As an example, let us consider the lovely *Agapanthus*. Though not a true bulb, it is often sold in stores with amaryllis (*Hippeastrum*) and other bulbs. The normal flowering season of *Agapanthus* is July and August, hardly a time when most people need or want a three-to-four-foot plant to bloom in the home. Granted, there are several dwarf types, but they would be better used in tubs on the terrace at that season. A better choice would be the amaryllis (*Hippeastrum*) itself, which can be flowered from December to April, a time when indoor growers are more likely to appreciate it.

Bulbous plants usually need a dry resting period which corresponds to the dry season in their native habitat. The majority of flowering bulbs need good light and a well drained, friable potting soil plus some bone meal. Supplemental fluorescent light can easily be provided in the home if light intensity is too low. Bulbs preferring cooler temperatures, such as lachenalias, may be grown in a cool room or on a porch where temperatures will remain above freezing.

Amaryllis

Perhaps the best known, and certainly among the most colorful tropical bulbs are the modern amaryllis (*Hippeastrum*) hybrids with large, broad, open flowers that can measure eight or nine inches across. The bulbs, which are of good size, have two stout flower stalks. Red, scarlet, pink, salmon and orange are some of the colors found in these hybrids, and plants with striped flowers are not uncommon.

Enterprising dealers often sell amaryllis bulbs already potted. If you buy bare bulbs, which are available from November through March, pot them up in a good soil mix, covering about half the bulb with soil and leaving the top part exposed. Slightly tight potting, as in six-inch pots, is best.

Place the potted amaryllis bulbs where they will receive gentle heat from below, and do not water for about two weeks. The flower spike will usually appear first, then the leaves. Give plants more water after leaves start growing. It may be necessary to support the spike, since bulbs often flower before making roots.

Amaryllis bulbs are expensive, so good after-care is advisable. Cut off the flower spike when blooms fade. Keep foliage growing all summer, with plenty of water and food to build up strength for the following year's flowers. The pots can be plunged in the ground outside for the summer. If you keep them inside, give them good light and water until October, when they can be rested.

In December or January, top dress the pots, scratching away some of the surface soil and replacing old potting mix with some good soil enriched with bone meal. Any small side bulbs can be removed and grown on, or they can be left to form a specimen plant which will have several spikes. The flowers may not be as large as with commercially produced bulbs, but a pot with more flowers is very pleasing, even when individual flowers are smaller. These showy hybrid amaryllis, developed from several South American species, may be listed under confusing names, so selecting them by color is a practical way to order.

Clivia and Lachenalia

The Kaffir-lily or *Clivia* (formerly *Imantophyllum*) is in the same botanical family as the amaryllis. Clivias are from South Africa and are probably better all-round

Roche

A spectacular three-bloom amaryllis (*A*. 'Imperator') is a fine example of both the plant breeder's art and excellent culture.

Photos: Charles Marden Fitch

Above left, *Cyrtanthus mackenii* hybrid with coral-peach flowers. Above right, *Amaryllis* "Carnival," a new striped African hybrid. Below, cutting the old amaryllis scape close to the bulb to prevent bulb rot. Always use a clean blade, dipped in alcohol after each cut, for any pruning of plants.

house plants than amaryllis because they have good foliage through the year (see cover). However, we cannot expect the same wide range of color as that obtained from amaryllis. Clivias have fleshy roots, not true bulbs, so pot single crowns in six-inch pots and larger specimens of several crowns in ten- or twelve-inch pots or tubs. There should be no drastic dry rest, just a moderately dry period in December and January. Clivias are rich feeders so give liquid fertilizers freely during the growing season.

Plants available are usually hybrids of *Clivia miniata* and *C.* x *cyrtanthiflora*. They bloom in winter, bearing clusters of lilylike flowers in shades of orange, red or pink on eighteen-inch stems. Blooms last for two weeks when cut. Clivias resent disturbance, so grow them for several years in the same container before repotting. Division of the plants can be done after flowering. Clivias are able to grow in low light but need good strong light for an abundance of flowers.

The Cape-cowslips (*Lachenalia*), also from South Africa, belong to the Lily Family. They must have a complete dry rest after growth is complete. They prefer cooler temperatures, needing only enough warmth to keep out the frost. A 50°F night temperature is ideal. The bulbs are small, so a half dozen can be planted in a six-inch pot, with the tips of the bulbs just at the surface. They like good light and if kept cool, can be enjoyed for two months. Strong bulbs will produce three or four spikes of tubular, bell-shaped flowers. Those usually offered are cultivars of *Lachenalia aloides*; *'Aurea'* is bright orange-yellow; *'Nelsonii'* is bright yellow; *'Quadricolor'* is red at the base, greenish-yellow in the middle, and green at the outer edges.

Lachenalias make attractive hanging baskets. If you wish to grow them this way, prepare a wire basket with moss lining. Plant some of the bulbs upside down at the base, about three inches apart, plant others on their sides at the sides of the basket, then plant still others upright at the top, filling in the potting mix as you go. Any *Lachenalia* can be used, but perhaps the best for this purpose would be *L. bulbiferum* which is red-purple and yellow in color. After flowering, watering should continue until the leaves start to yellow. Then dry the plants off until the end of August when the bulbs can be repotted. Small bulbils can be grown on to flower in two years.

Eucharis, Veltheimia, Others

Eucharis, the Amazon-lily, is another bulb related to *Amaryllis*. Flowers are white, large and showy, but the plants are also of substantial size. Native of Colombia, they require temperatures of 65-75°F and higher in summer. *Eucharis grandiflora,* sometimes listed as *E. amazonica,* is the species usually offered. The stalked, oblong leaves are dark green, bold and attractive. Plants should never be allowed to dry out completely. A short period of drier treatment in autumn is often advocated, but ours are watered and fed the year round and produce two crops of flowers a year. They are four inches across and are borne on scapes about two feet high. Plants in twelve-to-fourteen-inch tubs are very handsome, and the flowers last well when cut.

Veltheimia is a small genus of South African bulbs belonging to the Lily Family. The bulbs are fairly large, and just one in a six-inch pot makes quite a show, although I prefer larger pots with several bulbs. The flowers are borne in dense clusters on a stout spike or raceme. They are pendent and tubular, and in *V. viridifolia* they are reddish with greenish tips. There may be up to thirty flowers a spike, each flower 1½ inches long. Veltheimias should be dried off when the twelve-inch-long straplike foliage turns yellow. Allow about two months dry rest. Plants prefer cool conditions.

Scilla peruviana, unlike our garden scillas, is not winter hardy in the cooler parts of the United States. Despite its botanical name as well as various misleading common names (Cuban-lily, Peruvian hyacinth), it is from the Mediterranean region. We grow this scilla under the same conditions as *Veltheimia*. The deep green leaves are nine-to-twelve inches long and radiate from the bulb. There are fifty to one hundred blue-violet flowers in a dense raceme on a short scape, with the lower flowers opening first. To me, the inflorescence in bud is perfectly beautiful. There is also a white form, *S. peruviana* 'Alba', but the flower heads are usually smaller. Scillas are in the Lily Family.

Cyrtanthus is a genus of plants in the Amaryllis Family. From South and East Africa come up to forty species, but few are seen in cultivation. Undoubtedly the best for home-growing are the *Cyrtanthus mackenii* hybrids. The bulbs are small so plant five or six in a five-inch pot. Because *C. mackenii* is a swamp plant, hence unaccustomed to a dry period, its progeny can be kept growing most of the year in the home. The narrow leaves are small, and there are five to ten tubular, fragrant flowers, each about two inches long. It is best to repot the bulbs every year since they make many bulbils. Grow them cool.

Vallota speciosa (*purpurea*), sometimes called Scarborough-lily, comes from South Africa. It is related to *Cyrtanthus* and has been hybridized with it. The plant and flowers are more like amaryllis (*Hippeastrum*), although *Vallota* usually flowers in August. Once potted it is advisable to let the bulbs become crowded in the container.

Repotting of *Vallota* is best done in June, at which time the crowded bulbs can be transferred to a larger container. Give plants a rest in winter, but do not let them become completely dry. Water them freely and feed them well with liquid fertilizer when they are growing. The flowers are bright scarlet, three-to-four inches long, several to a scape.

Enjoy the diversity of . . .

LIVING WITH BEGONIAS INDOORS

Joy Logee Martin

Begonias are uniquely adaptable plants for indoor culture. There is a variety for every location. Angel-wings enjoy a sunny window while the regal kind known as rex, with its paint-box markings, graces a shady corner. Tiny rhizomatous types can landscape terrariums or flourish under fluorescent lights. The bright flowers on wax begonias smile from gardens but these plants can be grown in the home as well, while the tuberous varieties are grown in the partially shaded patio or window box.

Begonias were named for the French botanist Michel Begon, a former governor of Santa Domingo. The genus, newly discovered at the time, was included by Linnaeus in his *Genera Plantarum* in 1737. The first Begonia, *B. nitida,* was introduced to England from Jamaica in 1777. By 1815 Kew Gardens could boast a collection of eight species. Today there are well over 1,500 species and many hundreds of cultivars.

A simple classification for begonias is to group plants according to the growth of the root system. The main categories are rhizomatous with a creeping thick rootstock, including the colorful rex; tuberous-rooted, with large fleshy bulbs; semi-tuberous, with swollen rootstock, including the various hybrids such as the hiemalis and Rieger types; and the fibrous begonias, by far the largest known category, in which is found the popular semperflorens or wax begonia. The fibrous group has been further subdivided into lesser groups such as the hairy or hirsute type, red-leaved types, felted-leaved types and angel-wing or cane type for easy identification.

Begonias are native to the warmer regions of the world. Plant hunters have searched the jungles of Africa, the mountains of the Orient and the tropics of Central and South America for new begonias. New species are being introduced every year.

Best Growing Mix

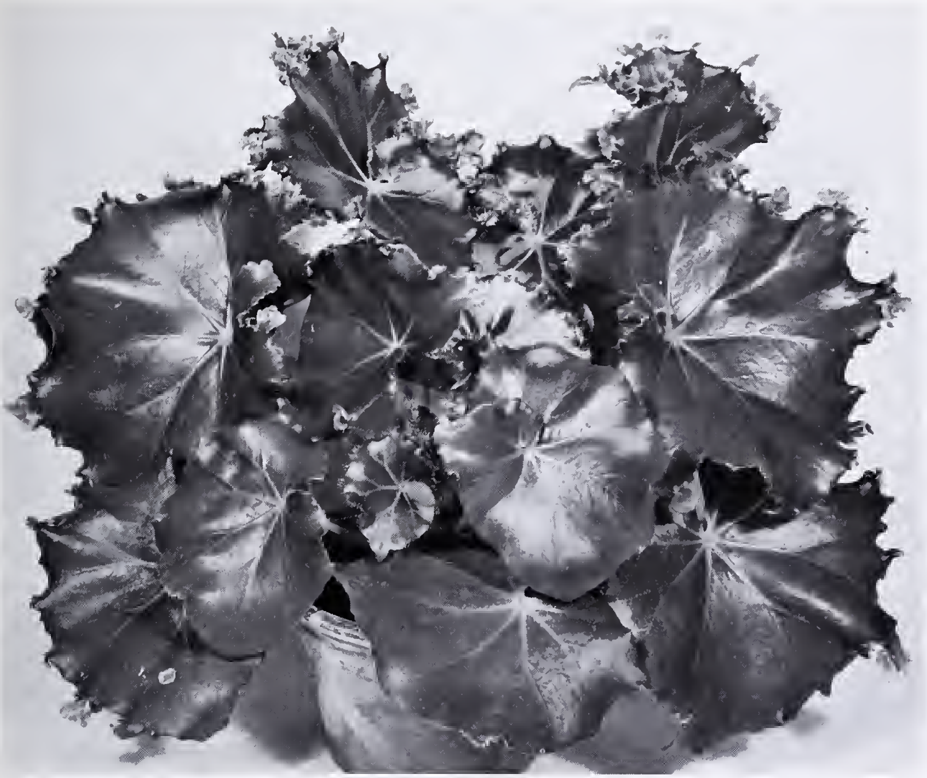
Begonias in their native habitat grow in loose rich humusy topsoil of the forest, or in sandy soils along banks and streams. For indoor culture in pots we try to imitate this type of soil. There are many prepared mixes useful for begonias. One of the best is a soilless mix consisting of one part peat moss, two parts chopped sphagnum moss and one part horticultural perlite. For each bushel of mix, a three-inch pot of bone meal and a handful of wood ashes is added. One can vary this according to what ingredients are available. The main point to remember is that the soil mix be friable or loose when moderately moist. To test for this, crush a handful of moist soil. If it falls apart when the hand is opened, it will grow fine begonias. If it remains in a ball it needs more organic matter.

Begonias are mostly shallow-rooted plants, especially the rhizomatous types with creeping rootstalks. Fibrous-rooted and cane types tolerate a heavier soil, provided they are watered with care. Good results can be obtained by using a mixture of one third each garden loam, sand and peat moss or compost. Bone meal should also be added to this mixture in the same proportions as given above. The wood ashes are used to bring out the color in leaf and flower.

Art of Potting

When potting begonias two rules are paramount: pot lightly and do not overpot in too large a container. Begonias like "tight shoes," as one expert stated. It is best to shift the plants when the rootball is firm and full of good healthy white roots. Make the shift to the next size pot—from a three-inch to a four-inch pot, for example, but not from a three-inch to a five-inch one. Water well and allow the plant to become slightly dry before another watering. This allows the soil to

Paul E. Genereux



Begonia x *erythrophylla* 'Bunchii', one of the rhizomatous begonias, has intriguing "lettuce-leaf" edges to the petals.

aerate and makes for healthier growth. Keeping begonias too wet will cause root rotting and wilting. This may also happen if the plant has been allowed to become so dry that it wilts. Such wilting may prove fatal with some types.

The type of pot used is not as critical as understanding the characteristics of the different types. Clay pots are excellent for people who have plenty of time to water their plants often. Because these pots are porous and drain well, the plants growing in them require more frequent watering. Plastic pots are useful for the busy gardener since they need less frequent watering. Crock shards or pebbles in the bottom of plastic pots are a must to keep the drain hole from clogging up.

For Every Exposure

Because there is such an enormous selection of species and cultivars of begonias, it is possible to find some that will grow in an east, west, north or south exposure and even where there is no natural light. In the latter case, fluorescent light is needed to substitute for the natural light, and excellent results can be had with this means of illumination.

For the flowering begonias, three or four hours of direct sunlight or the equivalent under artificial light is most important. This includes the semperflorens, cane types and angel-wing in particular, and for these an east or west exposure is best. The rex and rhizomatous types need less light and will grow in a north exposure or away from direct sunlight in a planter or on the table. During the long winter months in the northern states, more sun is necessary for flowering wax begonias and other winter-blooming types, such as hiemalis, some angel-wing, felted-leaved and hairy-leaved types. Dur-

Roche

A typical Christmas begonia, 'Lady Mack', requires relatively high humidity in a cool, well lighted area.

ing a long spell of cloudy weather, it is advantageous to provide extra light by placing plants near a reading lamp in the evening. This will help to keep the buds and flowers from falling.

Temperature and Humidity Needs

Begonias thrive in normal house temperatures of 68°-75°F. However, it is important that they not be grown day and night at the same temperature. In general, a nighttime temperature of 60°-65°F is satisfactory. Tropical species such as *B. pustulata, B. masoniana, B. cathayana* and the rare *B. goegoensis* can take a warmer daytime temperature—75°F or even higher—but the drop at night should never be more than five degrees; they will not tolerate cool temperatures or sudden changes.

Terrariums offer an attractive means of displaying and growing some of these tropicals, particularly the miniatures such as *B. tridicaulis, B. rotundifolia* and the *B. imperialis* group.

Humidity is important, but fresh air is even more important. In the normal home there is usually sufficient humidity, but if the air is dry, adding a humidifier is a great help. Keeping plants in trays filled with pebbles and water also helps increase humidity. It is important that the water level be kept below the base of the pot.

Fertilizing, Pests

One of the most frequent questions asked about begonias is, "How often shall I feed?" If the plants have been recently repotted, they will not need fertilizing for a few weeks. However, if they have been growing in a pot for some time, feeding is essential for good health. Every three weeks apply an organic plant food according to directions on the package. Once every four weeks during the short winter days in the North is sufficient. Care should be used not to overfertilize plants growing in small pots. Fish emulsion is one of the best fertilizers for begonias. Mix only what is to be used at once as some of the value is lost when it is allowed to stand for long periods.

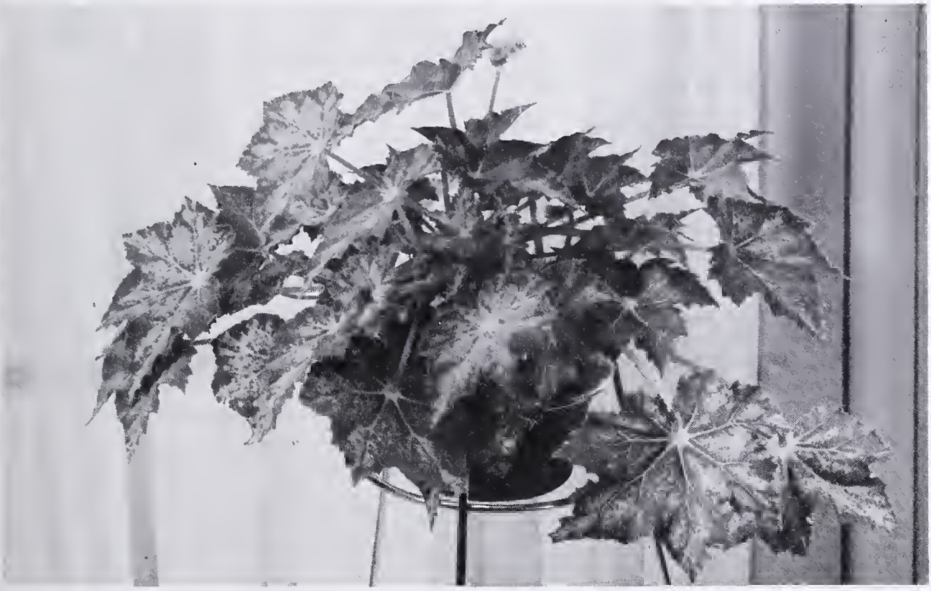
Begonias are relatively free of insect problems. They have a sort of built-in resistance since they have oxalic acid in their tissues. However, if exposed to white fly, scale or mealy bug, plants can suffer. A malathion spray can be used, being careful to keep the plant in the shade until the leaves have dried. Begonia mite is even more prevalent and causes the tender tip growth to shrivel. Pinch out the shriveled growth and then spray with any good miticide. More than one application may be needed to obtain complete control.

Powdery mildew, which most often appears during a cold damp spell, is bothersome mostly on tuberous-rooted, hiemalis hybrids and rex types. Plants should be sprayed at the first signs of tiny pin-prick gray spots on the leaves. These spots will spread fast if not controlled. There are several good fungicides available, Actidione being one of the best. Spray the entire plant, both above and on the underside of the leaves. This spray is colorless and leaves no residue. Keep the plant in the shade until thoroughly dry. One application will usually give good control if done thoroughly.

Increasing Plants Is Fun

Propagating begonias offers a fascinating challenge to the grower. In addition to propagating from seed, stem and leaf cuttings, one can divide the rhizome of the rex and rhizomatous types. In some cases the rhizome may already be rooted, particularly on older plants growing in large pots. Tap the plant out of its pot (this is easiest when soil is slightly dry) and shake off as much of the excess soil as possible. Pull the sections apart and repot into the correct size pot. If the plant is solidly rooted into a hard ball, it may be necessary to cut the sections apart with a sharp knife. This will not be harmful as there should be ample roots for each division to make new growth. Select the pot of the correct size so that the top growth will be in proportion to the pot. If some of the rhizomes do not have roots, they can be shallowly planted in sand until rooted. Then they can be potted.

Roche



Begonia 'Cleopatra', another rhizomatous begonia, demonstrates an open and fuzzy leaf with toothed margins, entirely different from the begonia on p. 49.

A Few Suggestions

Rex 'Christopher Robin', very large leaves with a blush of pink, surrounded by lacelike silver. 'Ember', flickering shades of silver, pink and rose interspersed with green. 'Fireflush', leaves resemble red velvet, flowers white and very fragrant. 'Iroquois', very compact growing with long, feather-shaped leaves of rose-pink with brown in the center. 'Vista', satiny black leaf with deep rose markings.

Miniatures 'Baby Rainbow', striking rainbow hues against a silver background. Often goes dormant in winter. 'Dew Drop', metallic surface delicately tinted pink forms a compact ball of silver. 'Peridot', tiny buttonlike leaves, dark red, silver spotted. 'Wood Nymph', miniature gem; thrush brown overlaid with silver.

Rhizomatous *Miniatures:* 'Bowtique', appears to be two leaves fused together, meeting at sinus in a double spiral. *B. prismatocarpa*, excellent for terrariums. Minute notched leaves form carpet covered with yellow flowers year-around. 'Enech', velvety jet-black leaves have green veins and red sinus. 'Bebe', tiny pointed lancelike green leaves make it look more like an orchid than a begonia.

On a grander scale: 'Hiro', a unique Japanese introduction. Curled silver leaves with ruffled edges accented in green. 'Madame Queen', huge coarsely ruffled leaves olive green above, blood red beneath. 'Freddie', glossy Nile-green leaves like giant water-lilies, flowers pink in winter. 'Emerald Lacewing', with deeply cleft emerald-green leaves. Profuse sprays of pink blossoms stand above the foliage. 'Patricia Ogden', rounded leaves have strikingly uniform black veins like zebra stripes, underside pink with maroon veins.

Angel-wings and Canes 'Jean Herr', deeply and irregularly cleft leaves are smoky gray and heavily flecked with light pink. *B. serratipetala*, serrate leaves of bronze-green covered with rose-pink dots. 'Posy Wahl', cupped leaves of deepest green with maroon black. Flowers shocking pink in large umbels held close to the foliage. 'Pinafore', low growing. Leaves are slate-green with deep red underneath. Bright salmon flowers cascade down in large umbels. *B. hemsleyana*, palmate leaves of shining green above and red beneath; bushy habit makes this species from China very distinctive. 'D'Elegance', another Japanese hybrid. Beautiful olive-green leaves are overlaid with raised "French knots." *B. deliciosa*, Borneo species. Red stems, dark green satiny leaves are deeply lobed.

Hairy Leaves 'Quinebaug', huge leaves, over a foot in size, are velvety green on top and maroon underneath. Bearded white flowers appear in spring. 'Lady Clare', palmate leaves with green upper and maroon underneath are deeply cleft to sinus with adventitious leaves at the center. *B. laetivirides*, a well branched, dwarf grower with long slender green leaves.

For Hanging Baskets *B. solananthera*, this "Brazilian Heart" begonia has heart-shaped leaves. The entire plant is covered with fragrant white flowers in winter. *B. limmingheiana*, spearlike smooth green leaves are adorned by brilliant coral blossoms in late winter. 'Delores', waxy maple-shaped foliage crowned in winter by profuse blossoms of light pink tipped in rose. A compact basket. *B. albo-picta*, called the "Guinea-wing" begonia, has narrow spotted leaves. Profuse umbels of creamy white flowers appear in fall and winter.

Semperflorens 'Ballet', double white flowers with a hint of pink contrast the deep bronze foliage. A neat and compact specimen. 'Cinderella', bronze leaves with crested blooms of pink overlaid with yellow. 'Dainty Maid', striking two-toned color; center of fully double flower pure white, outer petals and edges tipped with rose-pink. 'Cherry Sundae', is-called "Calla-lily" begonia for the white markings on its leaves. The large fully double flowers are cherry-red.

Tuberous 'Helene Harmes', a multiflora hybrid with ruffled double canary-yellow flowers. *B. grandis (evansiana)*, called the "hardy begonia," is an Asiatic species with broad green leaves, red veined with showers of true pink flowers. ☘

Charles Marden Fitch

How to successfully grow and propagate . . .

AFRICAN-VIOLETS

Alma Wright

Probably the most popular house plant we know today is the African-violet (*Saintpaulia*). It is easy to grow, lovely to look at, and thrives under a variety of conditions in our centrally-heated houses.

Success in growing beautiful, flowering African-violets the year around depends on observing a few simple rules which, if followed, will provide window gardening pleasure throughout the year.

Propagation

New plants may be propagated at any time of the year by means of leaf cuttings, plant divisions, offsets or seeds. The most common method is by leaf cuttings. From a healthy plant remove a crisp, medium-sized leaf of good green color and with a razor blade trim the end of the stem back on a slant to about 1½ inches in length. To avoid bruising stem tissues, leaves should be cut with a sharp knife, never pinched or broken from the parent plant. Lay aside the cuttings for about thirty minutes for the cut stem ends to heal. Sound young leaves taken half-way between the center of the plant and the bottom are best because they root faster. Do not use the older outside leaves for they are too mature and spent.

Cuttings may be rooted in several different ways. To root a cutting in water, cover the top of a water-filled drinking glass or other container with a piece of aluminum foil fitted over the opening. Punch a hole in the foil and stick the leaf

Saintpaulia Ballet strain hybrid 'Inge' (above) has dark purple, ruffled blooms with deep yellow anthers.

stem through the hole into the water. Place in a well-lighted window, but not in the sun. In two to four weeks roots should begin to show.

When these roots are ¼ to ½ inch long, and before small plants form, the leaf is ready to be planted. If preferred, cuttings may be left in water until small plants form. It is a matter of choice. Plant the rooted end of the leaf stem just under the surface, about ¼ to ½ inch deep, in a mixture of ⅔ damp peat moss and ⅓ damp vermiculite or sharp sand, and support the stem with a plant marker or crossed toothpicks so that it will not wobble or fall over and the tender roots be broken off. After small plantlets appear and have grown an inch or so tall, carefully separate them from the mother leaf. If their root systems appear to be developed fully enough for good plant growth they may be separated and planted individually in two-inch pots in a well-balanced soil mix. Plantlets with poor or insufficient roots should be returned to the rooting mix to grow better roots.

If several leaves are to be rooted you may prefer to use a wooden flat, aluminum pan, glass dish, or the pot-in-pot method and to plant the leaf cuttings directly in the growing medium without first rooting them in water. The peat moss and vermiculite mix with a few good-sized chunks of charcoal placed in the bottom of the pot or flat for drainage is recommended. Set the leaves out in rows, inserting each stem ¼ to ½ inch deep in the rooting medium. If the cuttings do not stand up properly after the mix has been firmed at the surface, brace them with plant markers or toothpicks. Care must be used in watering as the medium must not be allowed to dry out too much or be kept too wet while the leaves are rooting.

Another successful method is to plant leaf cuttings in a covered container. Battery jars, aquariums, or fish bowls are suitable. If one of these containers is used, place a thin layer of sterilized pebbles or broken charcoal over the bottom to provide artificial drainage. Then fill it to a depth of about three inches with the growing medium of peat moss and vermiculite or sand. Do not pack the mix down too firmly; level it lightly and leave it fluffy. Insert the leaf stem about ¼ to ½ inch deep in the growing medium taking care to press the mix firmly about the base of the cutting. Cover the top with clear plastic, Saran Wrap, or a pane of glass and place it in a well-lighted window that does not have direct sunlight. Provide ventilation by making a small hole in the plastic or Saran Wrap or insert a match stick between the rim of the container and the glass top. If the cover stays too misty, provide for a little more air. Cuttings rooted this way will not require much water but they should not be allowed to get too dry. An even humidity is the objective.

Propagation by rooting offsets (suckers) or dividing a plant which has several crowns is the quickest way to produce flowering plants. For offsets, gently pry the small plants loose from the old plant and set them to root in the growing medium. If they have not sufficient base to hold them steady in the mix, fasten them down with crossed plant markers or toothpicks until they have grown roots and are ready for potting. To divide a multiple crown plant, remove it from the pot and gently pull the sections apart without damage to the roots if possible. Plant each new crown separately, being careful to have the center of the plant free of any covering of soil. Do not plant too deeply or use a pot too large for the reduced size root system. Water moderately until new growth starts. You can re-root an old crown which has no roots by putting it in the growing medium until it develops an adequate root system.

Potting and Soil

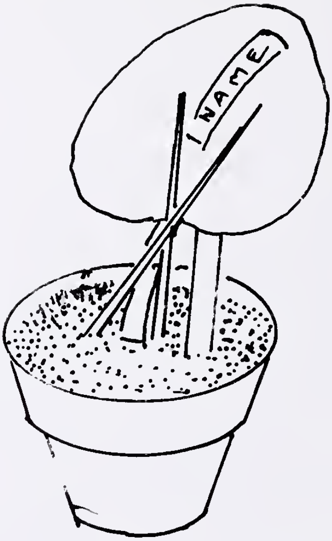
When the young plants are about two inches high they are ready to be separated and planted into soil. If more than one plantlet is produced from the leaf the little plants should be gently worked apart and each planted in a separate pot. A plant that appears to be weak or one with a poor root system should be placed back into the rooting medium to develop a more complete root system and grow into a sturdy little plant before it is potted.

A Dozen Do's for African-Violets

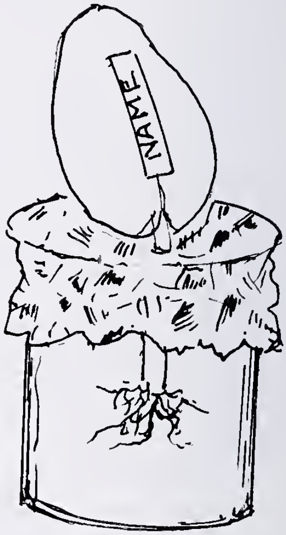
1. Do give plants adequate light. Good light is essential to good flowering. If no bloom try a different light exposure. A change in windows may prove helpful. A north or east light may be best.
2. Do use only warm or room temperature water. Never cold.
3. Do water faithfully. Keep the soil lightly and evenly moist.
4. Do provide good drainage.
5. Do always use a pasteurized potting medium containing plenty of organic matter. The potting mix should be fast draining, light textured and easily penetrated by fine roots.
6. Do feed regularly. Give plants very small amounts of fertilizer more frequently.
7. Do furnish plants humidity and proper ventilation. A buoyant atmosphere is healthful.
8. Do inspect plants daily.
9. Do remove the old blossoms and blossom stems. Take off old or damaged leaves. A well groomed plant is a joy.
10. Do cleanse the foliage with warm water when needed. Place out of light until leaves are dry. A dusty plant is not a thing of beauty.
11. Do isolate all "new arrivals" for several weeks before placing them with your other plants. Watch for signs of pests or disease.
12. Do experiment with growing techniques until you are successful. Do try out your new experiments on one or two at a time—never your entire collection.

A Dozen Don't's for African-Violets

1. Don't expect plants to flower without adequate light. Light promotes bloom. Don't allow plants to remain in bright, hot sunlight. The leaves will burn and bleach.
2. Don't water with cold water. Always warm.
3. Don't overwater. The soil should never stay soggy wet.
4. Don't let plants get too dry and then water heavily. Root rot can result if desert to swamp conditions occur too frequently.
5. Don't use a heavy soil medium that packs and drains slowly.
6. Don't overfertilize. Feed more often with a much weaker solution of fertilizer.
7. Don't overpot. Use a small pot for a small plant; pot up as necessary.
8. Don't expose plants to chilling drafts. If windowsill growing protect from the cold in winter when outside temperatures are low.
9. Don't subject plants to temperatures lower than 60 degrees. Avoid sudden changes in room temperature.
10. Don't forget the need for fresh air in the room. Stagnant, dry air is harmful.
11. Don't forget to read the directions on packages of fertilizer and pesticides before using. Read all instructions.
12. Don't give up if you experience difficulty growing plants. If you study your conditions and work at solving the problem, you will develop a successful growing technique.



With a clean, sharp knife or razor blade cut the leaf from the plant, leaving about 1½ to 2 inches of stem. An easy and fast way to grow leaf cuttings is to place the cut leaf in ⅔ damp peat moss and ⅓ damp vermiculite. Insert the stem ¼" to ½" deep in the medium. Firm medium around the base of the leaf. Brace the cutting if necessary. Label.



To root a leaf cutting in water, cover a water-filled drinking glass with aluminum foil and insert the stem through the foil into the water.

Water

African-violets do not have to be watered every day but a daily inspection of the condition of the soil is necessary. Keep the soil only slightly moist to the touch. They may be watered from either the top or the bottom of the pot; the only requirement is that the water be warm. Regular watering will produce better bloom. Saintpaulias do not do so well when the soil becomes hard and dry, nor do they thrive if too wet—swimming is not for them. Common sense in watering a plant is the best rule to follow.

Light

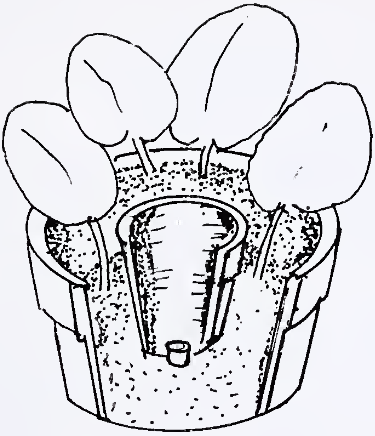
Probably the most important factor of all in producing good growth and bloom is proper lighting. African-violets will grow well in any window where they get plenty of light—but not strong sunlight. Plants must be kept out of the direct rays of the sun, except in mid-winter, when the mild light of the December or January sun encourages growth and bloom.

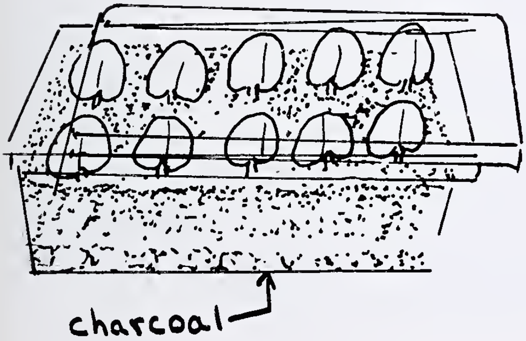
Many African-violet enthusiasts have turned to fluorescent lighting with marvelous success. Lights are placed about twelve to fifteen inches above the plant table and are kept on approximately fourteen hours a day. Tests have proven that 40-watt daylight tubes are about right for best results. A two-tube, 40-watt fluorescent fixture with one cool white and one daylight tube is recommended for good bloom. Additional incandescent light is desirable if the fixture is set up to permit the use of incandescent lamps.

Temperature and Humidity

African-violets will not thrive in an atmosphere that is too dry, too hot, or too drafty. An ideal room temperature is from 65 to 75°F with a relative humidity of from 50 to 60 percent. If the air is too hot

For the pot-in-pot method place a small loosely-stoppered clay pot in the center of a larger clay pot and keep the small one filled with water. Allow young plantlets to grow until they are 1 to 1½ inches tall before separating them from the parent leaf. Gently pull the largest of them away from the leaf—and the other little plants—being careful not to damage the root system. If there are tiny plants too small to separate, return the leaf to the rooting medium.





If several leaves are to be rooted it may be preferable to use a pan or other type of flat container. Place a layer of charcoal over the bottom. Fill with rooting medium. Smooth. Make small holes in rows about ½″ deep and 2″ apart and insert the leaf stem. Firm the medium around the base of the leaf. Label. Water with warm water before placing in the window or under lights. Plastic shoe or bread boxes, with covers, act as Wardian cases, but never place in direct sunlight. (*Drawings by author*)

and dry the buds may drop off or the blossoms will fall off shortly after they open. At too low temperatures, plant growth slows down, flowering may stop, and the foliage will not be nice and flat, but will curve down around the edge of the pot.

Humidity may be increased at plant level by grouping the pots close together, by placing them on moist pebbles in a shallow tray, or, in the case of a single plant in a clay pot, by setting the pot in a larger jardiniere. The jardiniere will hold moisture around the pot. To increase moisture in the whole room, pans of water may be placed on the radiators or other heating equipment.

Fertilizer

After plants begin to bud and bloom they should be fed with a complete soluble fertilizer about once a month. Do not overfeed; use as the manufacturer directs. If sheep or cow manure is preferred, apply it, in small amounts, directly on the soil at the edge of the pot, or in liquid form when the plants are watered. Manure solution is highly praised by many experts. It is made by pouring boiling water over dehydrated manure. Let it stand several days, then dilute the concentrated solution until it is about the color of weak tea. Use for regular watering.

With these simple rules, anyone with a reasonably "green thumb" should succeed with African-violets.

Variegation

African-violet plants with variegation in their foliage need to be grown in as cool an area as possible during the summer months. Place them under the center of the lights on the bottom shelves where it is cooler. Feed with a plant food low in nitrogen. An excess of nitrogen will cause the plant to lose its variegation.

How to grow and propagate . . .

GLOXINIAS

Albert and Trudy Buell

Awakening among the charms of spring, the gloxinia (*Sinningia*), house plant of unparalleled beauty, may without apology add her brilliant blossoms to complement Nature's outdoor loveliness. Such a color range as the hybrid gloxinia presents is a bit difficult to describe. All flower shades from delicate pinks to vivid reds are represented, as well as the darkest purples, the purest whites, and fine specklings on lightly tinted backgrounds. Throughout this gamut of color, the two types of gloxinia, bell-shaped and slipper-shaped, vie for admiration and attention.

The leaves of the gloxinia are both interesting and attractive. On some varieties they are extremely hairy, while on others they are nearly smooth. The size of the leaves varies a great deal, some measuring as much as fourteen inches long and ten inches wide.

Well developed plants of the larger kinds often have forty flowers open at one time and one of our record plants has actually had as many as 102 blossoms showing at the same time. No other house plant offers such breathtaking reward for the effort spent in growing it.

Gloxinias are easily grown, and any flower enthusiast can achieve success in his efforts to produce gloxinias which have attractive foliage and admirable flowers. However, some skill is required to grow them well, and unlimited challenge is offered to the grower in the crossing of the different types and in waiting for the resulting seedlings to mature.

Soil

One of the first essentials is the preparation of the soil. We have found that gloxinias do best in a soil mixture that is rich and fibrous. A mixture of ⅓ good garden loam, ⅓ compost or leafmold, and ⅓ peat moss and sand in equal parts, has proven to be ideal for gloxinias. A four-inch pot of bone meal is added to each bushel of this potting mixture, or a little less than a cupful to a twelve-quart pail of soil mixture. Tubers that measure 1½ inches across or less should be potted in five-inch pots. Tubers that are larger in diameter should be placed in six-, seven-, or eight-inch pots. Good drainage is insured by placing one inch of crushed charcoal in the bottom of the pot.

Light

Light is probably the most important factor to consider in raising gloxinias. One of the growers' chief problems and the question they most often ask is, why do some plants become "leggy"? Almost always, this unattractive condition is due to insufficient light. Strange as it may seem, some plants require more light then others. Thus a plant which tends to be spindling should be given the sunniest spot possible. Occasionally, we have had certain plants continue their "leggy" trend until the sun became higher and the days longer sometime in March. Generally speaking most gloxinias do best in a south or east window where they can receive every possible bit of sunshine during the winter months. In the summer some shade may be necessary.

Leaf Cuttings

If the grower desires to produce tubers which will flower the following year he should start leaf cuttings in the spring and summer. Once in a while a cutting that has been started in March or April will send up a shoot within six or eight weeks which will blossom during the same growing season.

We have found that the leaf cutting should be taken as close as possible to the stem of the plant, where the leaf stem is hard. A leaf cutting having a hard stem will form a much better tuber than one having a soft, succulent stem.

Until quite recently, we used coarse sand for rooting our leaf cuttings. However, a mixture of half vermiculite and half native peat has more than proven its merit as a starting medium, not only for

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A floriferous Buell gloxinia hybrid showing good leaf form and flower placement. If light is from only one direction, as from a window, turning the pot every several days will help to develop form such as this.

leaf cuttings but for gloxinia seed as well. In the house, especially in the dry atmosphere of a steam-heated home, a goldfish bowl or terrarium seems to be ideal for leaf cuttings. These containers keep the air around the cuttings continuously moist—which is helpful in producing plants of excellent foliage and abundant blossoms. The leaf cuttings will also root satisfactorily in an ordinary clay pot.

When a tuber develops at the base of a cutting, it is ready to be potted. First it can be put into a four-inch pot and later on into larger pots, if necessary.

Gloxinia leaves may also be rooted by slitting them across the veins and placing them on the rooting medium. A plant should form at each break in the leaf. Still another method is to cut the leaf in sections, splitting the main vein. With both methods there is a risk of losing the cutting through decay. Neither method is to be recommended for choice varieties until experimenting has been done with leaves of the more common types. No matter which method of leaf propagation is chosen, the leaves should be taken from the plants while they are still a good, healthy, green color; *i.e.*, while the plants are still blooming. Mature or rested tubers produce the greatest show of blossoms.

Water

Gloxinia plants should never be allowed to become waterlogged. This is one of the foremost reasons for bud blasting or failure of the buds to develop fully. We advise applying water at the surface of the soil until it runs out of the bottom of the pot; in this way it can be determined how much water the plants have absorbed. They should not be watered again until the soil surface shows evidence of being dry.

Fertilizer

The amount of fertilizer required during the growing season will depend upon the fertility of the loam and leafmold which were used in the potting mixture. We have found that liquid fertilizer applied once or twice during the summer is adequate. This is prepared from one of the complete commercial fertilizers.

Rest

Beginning in September or October, gloxinias should be given a short rest. We repot the tubers as soon as the foliage dies down and before storing them for their rest period. The potted tubers can be kept in a basement or other dark place until new growth appears. They should be watered only enough to prevent extreme withering.

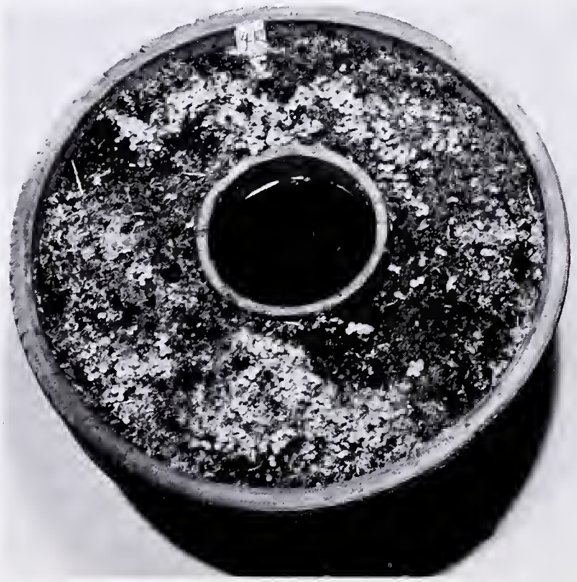
The nature of the individual plant will largely determine the start of the new growing cycle. Some tubers require only a short rest, or dormant period, while others are very slow in starting. We have had, occasionally, a tuber send up new growth before the old top dies down and we have found that such growth will produce just as fine a plant as if the tuber had taken a two-month rest before growing a new top. If no growth of a plant is apparent within four months, the amount of water should be gradually increased.

Plants which produce an early crop of blossoms in the spring can be cut off just above the first pair of leaves and thus be made to produce another good display of flowers within ten to sixteen weeks. However, this second flowering may delay the next year's flowering until summer. In preparation for its rest the mature plant should be given less water.

Raising from Seed

Growing gloxinias from seed presents a never-ending field of experiment and anticipation. There is no particular difficulty involved and beautiful flowering plants will develop within five to ten months. Seed that is sown in July produces the best results in our area. Any of the accepted methods of germinating fine seed and handling small seedlings will prove satisfactory. We use the following method. The seed pot is filled with a mixture of vermiculite and native peat, which is loose and lightly packed down. In the center of this we place a much smaller pot, the drainage hole of which is corked. The small pot is kept full of water which slowly seeps through its sides, keeping the planting medium in the seed pot moist. Under dry conditions, extra watering may be necessary, especially if the seed comes up and the seedlings are weak.

The seed will germinate within six to ten days. As soon as the seedlings are



Roche

The terra-cotta pot-within-a-pot method to keep seedling growing-medium evenly moist and to avoid disturbing the little plants.

large enough to handle, *i.e.*, when they measure approximately ⅜ inch across the true leaves, they should be transplanted. As the plants develop it is, of course, neccessary to repot them into larger pots. A night temperature of about 62 to 68°F is desirable during the fall, winter, and spring months. Only fresh seed should be planted because its viability decreases greatly after it is a year old. Seed that is sown in July should produce flowering plants the following spring and summer. By the time they are ready for their resting period they should have tubers measuring from two to three inches in diameter. These tubers, planted in November, produce the largest specimens we have ever grown or seen, although smaller tubers started in the fall will produce excellent specimen plants.

Pests

Thrips are the insects most likely to cause trouble. A rusty appearance of the leaf stems usually indicates their arrival. Their control is comparatively easy with carbaryl if young plants are dunked in a solution of 50% wettable powder (2 tbs. per gallon of water). Repeat applications are usually necessary.

Three other insects which may give considerable trouble to gloxinia enthusiasts are aphids, mealy bugs, and cyclamen mites. Aphids can cause a great deal of damage but they are easily controlled. The most effective spray for all types of aphids is nicotine sulphate or malathion. Mealy bugs will sometimes attack gloxinias although they prefer other plants. We have been told that cyclamen mites can be stubborn pests although they have never been one of our problems; Kelthane and other miticides used according to directions, are reported to provide control.

There are many conjectures regarding the appearance of spots on gloxinia leaves and also leaves that suddenly die. Various things may cause these unsightly difficulties; some of the causes are unknown. The leaves of some strains of gloxinias turn black very easily and plants having buds that blast easily are also apt to be weak in this respect. If leaves of a plant that is in a warm, sunny window are splashed with cold water, they will often turn black. Also, if plants that are rather wilted are handled while in hot sun, their leaves will often show the same damage. If the plants recover, the leaves will have burned-looking spots on them. Although sometimes only the leaf's surface tissues may be broken by sudden temperature changes, more often the injury penetrates the whole thickness of the leaf. This type of spot does not spread and quite often the color will come back to a leaf suffering but slight surface injury.

There is another type of leaf spot that is rather common and quite different from that just described. It is caused by a disease that spreads especially in cloudy weather when the humidity is high. When this condition exists, water on the leaves will spread the spores of the disease from one leaf to the next. Sufficient ventilation, so that moisture is not allowed to collect on the leaves, is the remedy for this kind of leaf spot. Also, any leaves that are in a dying condition, especially if they appear to have mold on them, should be removed and burned.

In our gloxinia breeding work we have not tried to produce plants which come true to color from seed by pollinating flowers on the same gloxinia. Such a practice as this would result in decidedly inferior plants. Our chief goal has been rather to achieve an excellent assortment of colors on plants that are easy to grow. Consequently, after several years of careful selection and hybridization, most of our large-flowered gloxinia hybrids have blossoms measuring over five inches in diameter. Almost every color combination is afforded, with the possible exception of yellow, though some of the blossoms have throats that approach a near-yellow or cream color. Many of the blossoms are ruffled. Some flowers are exquisitely marked and delicately shaded, others are solid red or purple or have fused shadings and variations of color with contrasting borders. Still others are resplendent in spotless white, blending in beauty with those having varied colors for backgrounds.

There are gloxinias in the future for all who enjoy growing the less common plants. ⁂

Poinsettia, Christmas cactus and other . . .

HOLIDAY PLANTS

Mary Lu Parks

Your chances for success with holiday plants are better than ever. If you select the plants carefully and provide the proper environment, they will reward you with extended flowering. This is due in good part to plant breeders who continue to develop superior cultivars. Their research brings wider color ranges, more blooms, better growth habits, new sizes and greater tolerance to growing conditions in the modern home.

Many of the new selections are patented and are identified with tags which give the cultivar name, the breeder and the care required for optimum performance. Look for these tags when you shop.

Purchase and Care

It is important to select a healthy-looking plant. There should be no signs of wilting, the leaves and flowers should be unblemished and the plant should be free of insects and disease. Avoid plants with yellow foliage or ones which are losing leaves. Check the flowers. They should be at least halfway open. Avoid a plant which has some faded blooms. Touch the soil. It should not be dried out, because it is difficult to restore moisture to the new soilless mixes. Select from a store which does a large volume of business or has a fast turnover. Better still is to buy from a florist who assures fresh quality. Be sure the plant is protected by some kind of wrapping (preferably paper) before taking it outside in the cold weather.

At home, provide proper water, light and temperature. Water and light are critical, since plants grown for their flowers require more frequent watering and more light than foliage plants. Check regularly; you may have to water them every day. Most should be placed near a window with a southern exposure.

Avoid hot and cold drafts from outside doors, heat vents in the winter and air-conditioning vents in the summer. Home temperatures are fine for most holiday plants except those grown cool, such as cyclamen and Christmas cactus. These plants must be accommodated by placing in a cool room or on a windowsill. Feeding is not necessary, unless you wish to try your hand at reflowering the plants, and then feed only when the plants have stopped blooming and are beginning new growth.

Poinsettia and Other Favorites

Pointsettias are an excellent example of the breeders' work. Natural characteristics to be overcome were excessive plant height (eight to ten feet) and the bad habit of dropping leaves indoors. Today, poinsettias have been scaled down to decorate homes. Plants now come in all sizes of pots including the small four-inch and hanging baskets. The foliage and bracts (large red modified leaves) have the ability to hold and flourish for months. Due to their remarkable holding quality, you can select a modern poinsettia right after Thanksgiving and enjoy it all through the Christmas season. Choose one with the small yellow and red flowers, located in the center of the bracts, just opening. Bract colors can be red, pink, white or variegated bicolors.

Poinsettias are photoperiodic (short day length triggers the flowering response), and to reflower them you must provide fourteen to fifteen hours of darkness each day for five to six weeks ("short-day" treatment). In spring, cut back the stems to six or seven inches above the pot. A poinsettia can be planted outside during the summer in partial sun, and then brought inside in autumn for the short-day treatment.

Other photoperiodic plants are Christmas cactus, kalanchoes and chrysanthemums. Kalanchoes are available in a range of colors from yellow and orange to pink, rose and red. Popular cultivars are 'Irwin', 'Norbert Bull', 'Melody' and 'Aztec'. Blooms should last up to a month in the home. Provide bright light to keep the colors from fading, and remove blooms when faded. The new cultivars have such a strong flowering response

Three Enchantment lily bulbs in a six-inch pot. These fragrant, hardy lilies can be planted outdoors after the last frost for a permanent addition to the garden.

Ball Seed Company

that they sometimes will form new buds and rebloom in four to five weeks; try it and see. Or you can initiate the flowering response by providing fourteen to fifteen hours of darkness for five to six weeks.

Christmas cactus has a wide flower color range, including white, pink, salmon, red, magenta and lavender. Choose a plant with many buds and take care to insulate it on the way home. Buds and blossoms tend to drop if subjected to sudden changes in temperature and light. They prefer a cool room or windowsill (east or west). To reflower, keep the plant cool, water sparsely and provide thirteen hours of darkness for five to six weeks.

Showy greenhouse chrysanthemums (florist pot mums), with large and decorative flowers, hold up well in the home for nearly a month. Basic colors are yellow, white, pink and bronze. There are many different flower forms, including daisies, spiders, pinwheels and even a carnation form. These mums are extremely difficult to reflower and should be discarded after bloom.

Another group of greenhouse-grown chrysanthemums, known as garden mums (incorrectly called hardy mums), are often sold as pot plants in the spring. After enjoying them indoors, transplant outside in a sunny or partially sunny location. They will rebloom in the autumn and, if protected with a heavy mulch of leaves or straw, may winter over to bloom again.

Azaleas, Rieger Begonias and Lilies

Azaleas in bloom are usually available from Christmas through Easter. The majority are patented cultivars which are extremely showy for two to four weeks. The "forcing azaleas" do not winter over outdoors in most climates but benefit from being in the garden for the summer. Azaleas prefer filtered sun, acid soil and frequent watering. Buds form during late summer. Cool night temperatures in autumn will swell the buds but plants must

Pan American Plant Company

'Ruffled Spirit', a carnation-form pot mum, will bloom in the home for nearly a month. Reblooming is not easy, so the plants are customarily discarded, like cut flowers, when blooms have gone by.

be brought inside before a killing frost. Provide both extra humidity, by misting to keep the buds from drying out, and a good light source (southern exposure). Remove any "feathers" or green shoots which grow around the buds. In about eight weeks, there should be beautiful blooms, though not as profuse as in the original flowering.

Most cyclamen need cool temperatures (55° to 60°F) to keep blooming. Keep in a cool room or on a windowsill. Choose a plant with evidence of buds still forming under the canopy of crisp, firm foliage. Popular at Christmas and Valentine's Day, cyclamens can be placed in the garden for the summer. In autumn, bring them in for reblooming. Newer types of cyclamen called "miniatures" are smaller and won't outgrow their four-inch pots. They have been bred to tolerate warm home temperatures and will flower year round.

Rieger begonias were developed from the Christmas begonia and Socotrana begonia. They have a brilliant array of colors and plants do well in pots and hanging baskets. They can be kept blooming five to eight weeks or even longer with good care. Select a healthy-looking plant, with no sign of disease on the leaves or flowers. They like an east or west window. Keep Riegers pot-bound. Water plants thoroughly, then allow them to dry out before rewatering (about once a week). If the plant develops mildew, you should discard it because treatment is difficult.

When selecting an Easter lily, find one with a bloom open and with as many buds as possible (three to five is average but you could find six or seven). As each flower opens, remove the yellow anthers to prolong the bloom. Remove the flowers as they fade. Easter lilies are very difficult to rebloom under home conditions, but if plants are set out in the garden, a few may flower again and live over the winter, depending on your climate.

Hybrid lilies are another story. Most are winter hardy and can be planted outside after the last frost to bloom year after year. These colored lilies are becoming more available as holiday pot plants. To prolong blooms in the house, keep lilies cool and near an east or west window.

This listing of holiday plants is not complete, but it covers those which are most popular and readily available. In summary, if you select carefully, provide generous amounts of light, correct amounts of water and the proper temperature, you can meet the challenge of maintaining and reflowering these beautiful plants. ✤

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> **he plants it for posterity.**
> **—Alexander Smith**

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BROOKLYN BOTANIC GARDEN RECORD / PLANTS & GARDENS
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THE YEAR'S HIGHLIGHTS IN GARDENING & HORTICULTURE

Gardening with Shakespeare at BBG
Outstanding English Gardens
Japanese & Chinese Bonsai

also

Rebirth of the Cold Frame
Coping with Deer
Hydroponics on a City Terrace
Recent Nontechnical Books & Articles

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LETTER FROM THE BROOKLYN BOTANIC GARDEN

The Winter Issue is devoted largely to a selection of outstanding horticultural articles that have appeared in other publications in the previous year. Let us take this opportunity to thank the contributors as well as the publications which have given permission to BBG to share these articles with members.

The past year was one in which consumerism, for the absence of a better word, began to catch up with horticultural reporting. It has a long way to go, for gardening is a gentle avocation and its practitioners do not always protest loudly if a catalog-proclaimed "everblooming" shrub descends into all green after the customary several weeks of flowering, or if the new pair of pruning shears from the discount store begins to fall apart after meeting a marigold stem. *Caveat emptor*, the ancient Roman king of the markets, still reigns in the hearts of the timid.

But things are changing. People are speaking up, even in gardening magazines. Peat moss often has more in it than the listed ingredient, according to W. L. Bluhm in *Ornamentals Northwest*—for example, weeds, *Pythium* and *Fusarium* fungi, and possibly other organisms. Commercial potting soils can be just about anything, laments George Waters in *Pacific Horticulture*, reporting on University of California research. And bone meal today is like diluted milk toast compared with what it used to be, says Milton Carleton in *News and Views*.

Gilbert Daniels, President of the American Horticultural Society (and alumnus of the BBG Children's Garden), has another "beeve." It's the garden books that wend their way from England to America as "international" editions. Most of them are as international as Bertie Wooster's bangers. Timing of garden practices and even garden practices themselves are different. Many of the plants mentioned, especially cultivars, are unknown here. And when they are, it is no service to lead unsuspecting New Yorkers to try to grow plants from the southern hemisphere, which are common in England because of the mild winters there. (Much of England has winters no colder than Tidewater Virginia.)

The United States is a large country and its climate is tremendously diverse, making it very difficult to do even "national" garden books of lasting value. There is a noticeable shortage of them. But to foist "international" editions (which are proportionately more profitable) on American gardeners who are just getting started, is unfair. It is also short-sighted economics, for it will turn many confused beginners away from horticulture.

To end on a more pleasant note, bonsai continued to be very popular in the past year and prices for well grown specimens and even their containers increased. A friend recently sent us this poem she had seen displayed at a recent bonsai exhibit:

There was an old woman from Scott
Who kept a dwarf tree in a pot.
They said she was crazy,
A pot's for a daisy,
But now it's worth more than her yacht.

Good gardening in 1980!

Sincerely,
Frederick McGourty, Jr.
Editor

To grow or not to grow, that is the question . . .

Estelle Gerard

The new Shakespeare Garden at BBG

GARDENING WITH SHAKESPEARE

Lucy Chamberlain

It is frequently pointed out that Shakespeare's works have a universal appeal, but certainly they hold a special interest for the gardener and nature lover. Shakespeare's vivid use of nature imagery and references to growing things are found throughout his plays and sonnets. Altogether there are more than one hundred fifty different plants mentioned by the Bard of Avon. Despite their frequency, the images he uses with these plants never seem contrived or conspicuous by their presence. Above all they reflect an understanding and appreciation of nature which could only have been acquired through a close and direct observation of nature itself.

Old and New Gardens

Because of the continuing interest in Shakespeare's works and his frequent mention of plants, many public and private Shakespeare Gardens have been created in England and the United States. Here at the Brooklyn Botanic Garden the original Shakespeare Garden dates from 1925, when Henry C. Folger, founder of the Folger Shakespeare Library in Washington, D. C., made a special donation for it. The garden was meant to be used by the participants in the Children's Garden Program. Located adjacent to the south field of the Children's Garden, it was laid out on either side of a flagstone path with plantings of herbs, flowers, shrubs and trees which Shakespeare mentioned. A wooden bench provided a pleasant spot for children to rest after a hot day of working on their garden plots. In addition, during the summer months the garden was a quiet place to sit and read from a set of Shakespeare's plays and sonnets which was kept in the Children's Garden House.

Over the years the plants became shaded out by a planting of Austrian pines nearby. By 1977 it became clear that the garden would have to be moved and redesigned. A new location was chosen in an open area north of the Administration Building and near the Fragrance Garden for the Blind. Unlike the old site, this one had the advantage of being accessible to all visitors.

The design for the new garden recalls an English cottage garden of Elizabethan times. The garden is set on a bank along a serpentine brick wall. Its plantings are designed around an oval brick path, and there is a teak bench which provides a comfortable place to sit and enjoy the garden. The actual plantings include more than eighty of the plants mentioned in Shakespeare's works. An attractive photoplate labeling system was devised to identify these plants. Each label bears the common or Shakespearean name and the botanical name, as well as citing two or three references for the particular plant. Large labels for more prominent plants include a graphic drawing accompanied by a description of the plant's uses and importance, especially in Elizabethan times. In addition, each of these large labels has a quotation from a play or sonnet.

Why Not Your Own?

Since the new Shakespeare Garden opened, a surprising number of visitors have expressed an interest in learning how to start one of their own. Creating any new garden requires planning and forethought on what the final effect should be. Climate, topography, water supply, available plants and maintenance are all factors to consider. In addition, there are many variations on the theme of a Shakespeare Garden. Some kinds include only the herbs and flowers mentioned in Shakespeare, while others have plants grown in the gardens of Shakespeare's day. Some are bedded out in dazzling displays of twentieth-century versions of Shakespearean plants. One of the first decisions that should be made is what type of Shakespeare Garden is wanted. It is of course possible to select just a few plants and grow them as a collection in one corner of the garden, but consider the other interesting and imaginative options.

A problem likely to be encountered is that of identifying and locating old and wild varieties of plants or, in some cases, species which are not readily available. Substitutions may be necessary. Also, some Shakespearean plants are not able to tolerate the extremes of climate in various parts of the United States and will require protection or overwintering indoors. Even so, there are many possibilities.

Regardless of what design is finally decided upon, become acquainted with popular gardening books and herbals of the sixteenth and seventeenth centuries. These books are filled with detailed accounts of every aspect of laying out a garden, including elaborate illustrations of knots and designs of raised beds, information on what materials to use for paving walks and building walls, and recommendations on plants as well as some sound horticultural advice which still holds true. The herbals are also useful tools for identifying some of the plants which are mentioned only by their old common names.

The formal pleasure gardens of the Elizabethan day were usually completely enclosed by a brick wall or a high dense hedge of material such as privet or whitethorn (English hawthorn). The garden was entered by way of a main gate, which in more elaborate gardens might have been made of wrought iron with stone pillars. Near the house were ter-

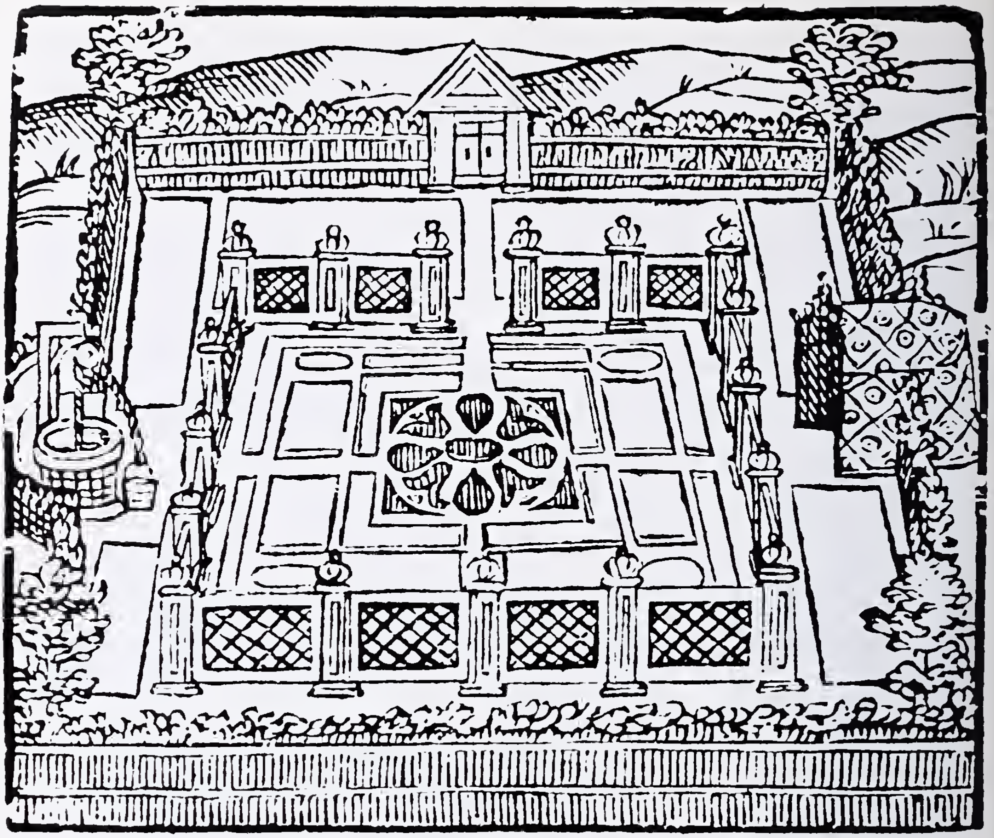
A Tudor kitchen garden with raised herb beds; note the fruit trees on the left and the pot herbs on the right; from a contemporary woodcut.

races from which it was possible to view the entire garden. The plan for the garden was based on a geometric four-plot design, paralleling the lines of the house. Each individual section had a plan of its own, whether a knot garden, a maze or raised flower beds. The effect was that of several smaller gardens within the largest garden. Paths were rarely turfed, rather made of fine gravel and sometimes planted with aromatic herbs such as thyme, mint or chamomile. These herbs gave off a pleasing fragrance when crushed underfoot. Chamomile was commonly used instead of grass in open areas. Walkways were often lined with linden, hornbeam, willow or whitethorn whose branches were interlaced overhead, forming shaded green archways to walk under. These alleys were interplanted with fragrant shrubs and vines such as rosemary, eglantine, honeysuckle and jasmine. The alleys frequently led to a small trellised arbor with a place to sit and view the garden.

As in medieval gardens the beds were often raised with boards to improve the drainage. The beds were commonly laid out and edged with evergreen herbs such as winter savory, thyme, germander, santolina, thrift and dwarf box. These herbs lent year-round interest to the garden. Intricate patterns of herbs, known as knots, were interplanted with groups of spring-flowering bulbs and plants. Colored stones and crushed brick were sometimes placed in the open spaces of the patterns. An example of an Elizabethan knot garden can be seen in the Brooklyn Botanic Garden's Herb Garden.

Flowers, Orchards, Kitchen Gardens

The Elizabethans seemed to take a particular delight in flowers. Not only were flowers planted in beds, but also beneath the trees in the orchard and along the walkways. They were planted much more sparingly, however, than today. Garden ornaments were apparently abundant in these pleasure gardens. Lead vases and various other urns with flowers in them were placed along walkways. As with the



The Tudor knot garden, a combination of culinary and medicinal herbs and highly-stylized landscaping.

medieval garden, the fountain remained the central focal point of the garden. Other fanciful decorations included topiary, carved wooded animals, statues and sundials.

In the great Elizabethan manor houses, the orchard and kitchen garden were two areas which were usually kept separate from the ornamental pleasure garden. The orchard supplied the household with a variety of fruits and was commonly located on the northeast side of the garden. The reason for this was to provide a windscreen for the tender shrubs and herbs being grown in the pleasure garden. Frequently in smaller homes, the orchard served also as a pleasure garden, having a fountain in the center, arbors and walkways. Herbs, both culinary and medicinal, made up a large part of the sixteenth-century kitchen garden, which was located off to the side of the house. Vegetables, potherbs and medicinal herbs were each planted in different sections of this garden. Very few flowers having only ornamental value were grown in the kitchen garden.

These are just a few ideas and features of typical Elizabethan gardens one might wish to incorporate into a design for a Shakespeare Garden. Depending on a particular situation, the choice of plants may be limited. Climate, for example, varies greatly. If you live in the Deep South consider growing all the subtropical plants Shakespeare mentioned. Southern California would be ideal for some plants of the Mediterranean regions such as rosemary, lavender and laurel. Milder areas of the eastern United States are better suited for the tender wild plants of England such as sweet violets and primroses. If you are lucky enough to have a sunny enclosed area, you might want to attempt a miniature version of an orchard. The possibilities are endless.

The brief bibliography included here may provide more background and ideas, but the best primary resources are the works of Shakespeare themselves. A brochure, describing the Shakespeare Garden, as well as a plant reference list, will soon be available to BBG visitors and interested invididuals. Regardless of whether you actually plant a Shakespeare Garden, we hope that you will come and enjoy a visit to our newest garden!

Plants

Here are some plants mentioned in Shakespeare's works which could be used in designing a theme garden:

- Aconitum, Monkshood (*Aconitum napellus*)
- Apple, Crab Apple (*Malus sylvestris*)
- Apricot (*Prunus armeniaca*)
- Bay, Laurel (*Laurus nobilis*)
- Box (*Buxus sempervirens*)
- Broom (*Cytisus scoparius*)
- Burnet (*Poterium sanguisorba*)
- Chamomile (*Anthemis nobilis*)
- Carnation, Pinks (*Dianthus caryophyllus*, *D. plumarius*)
- Columbine (*Aquilegia vulgaris*)
- Crow-flower (*Lychnis flos-cuculi*)
- Crown Imperial (*Fritillaria imperialis*)
- Daffodil, Narcissus (*Narcissus pseudonarcissus*)
- Daisy, English (*Bellis perennis*)
- Harebell, English bluebell (*Endymion non-scriptus*)
- Hawthorn, English (*Crataegus laevigata*; formerly *oxyacantha*)
- Holly, English (*Ilex aquifolium*)
- Iris (several including probably *florentina, germanica, pseudacorus*)
- Ivy, (*Hedera helix*)
- Lavender (*Lavandula angustifolia, L. spica*)
- Leek (*Allium porrum*)
- Lily (*Lilium candidum*)
- Marigold (really Pot-marigold) (*Calendula officinalis*)
- Medlar (*Mespilus germanica*)
- Pansy (*Viola tricolor*)
- Primrose (*Primula vulgaris*)
- Quince (*Cydonia oblonga*)
- Rose, Damask (*R. damascena*)
  - Eglantine (*R. eglanteria*)
  - Musk (*R. moschata*)
  - Red (*R. gallica officinalis*)
  - White (*R.* x *alba*)
- Rosemary (*Rosmarinus officinalis*)
- Rue (*Ruta graveolens*)
- Thyme (*Thymus vulgaris, T. serpyllum*)
- Violet (*Viola odorata*)
- Wormwood (*Artemesia absinthium*)
- Yew (*Taxus baccata*)

Sixteenth- and Seventeenth-Century Gardening Books, Herbals and Related Literature

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Brooklyn Botanic Garden Handbooks, useful in designing a Shakespeare Garden:

68. *Herbs and Their Ornamental Uses*
36. *Trained and Sculptured Plants*
45. *Garden Structures* ❧

T. H. Everett

For more than sprouts . . .

THE BAMBOO CONNECTION

Rachel Snyder

Reprinted from The Garden Club of America Bulletin,
Summer, 1979

Bamboo's association with the Orient is so taken for granted that the full realization of its importance in the People's Republic of China came to me as one of the many surprises on the American Horticultural Society's 1979 spring tour to that country. As use after use of this unique plant—this grass that grows like a tree—was observed, I began to muse on whatever China might be like without it. Not nearly so far along, I imagine.

From south to north bamboo's role in construction was vividly obvious. Lashed end to end and crosswise, bamboo poles form temporary scaffolds many stories high for the repair of old or erection of new buildings. Bamboo forms the frames, walls and roofs of many houses and other structures.

Roughly woven baskets of split bamboo carry the bricks or stones of construction, or the dirt of excavations. When loaded they hang from shoulder yokes made of the same, a short stout culm of bamboo.

It takes no great leap of imagination to see back through time to these building and carrying implements at work on China's Great Wall. Doubtless it was levers of bamboo, and skids and ropes of it, that moved the huge dressed stones to their exactly fitting niches, and bamboo wedges that loosened each rude rock from its origin in the mountain. After the Wall was finished, probably it was defended for centuries by bamboo spears, and bamboo arrows shot from bamboo bows.

Today, admirable ladders are made of bamboo. A bamboo pole is the universal laundry dryer, extended at sun-up from

Freshly-cut bamboo "timber" (bamboo is a grass) in a forest in China. Bamboo is one of the most useful and versatile of all forest crops.

many an upstairs window. Brooms are made of bamboo, as are the dust pans. As for fences, little else is used, and you can find an infinite variety of artistic designs.

At a tea farm we noted bamboo in the gathering baskets and the drying mats. At a mushroom-growing project, the cases containing the spore-inoculated compost were simple shallow bamboo trays. At an orchestra concert we spotted bamboo in stringed and wind instruments. In a fine arts hand printing shop, we noticed the ink brush handles made of it. At an acrobatic performance the athletes used strong, springy bamboo rods in their balancing acts.

Came mealtimes, we ate with bamboo chopsticks, seated on bamboo chairs, with one course of the dinner consisting occasionally of tasty bamboo sprouts. At dining room windows hung lace curtains decorated with the graceful bamboo leaf design. In a Children's Palace in Shanghai little boys were putting together model airplanes framed with finely split bamboo, and in Peking's vast Tienanmen Square youngsters were flying fanciful kites ribbed with the same.

Uses in Horticulture

When it came to horticultural uses, the list became endless. Mats made of small canes were protecting coldframes where early vegetables were starting. More such poles were woven into long parallel windbreaks across the fields, set at right angles to north winds every twenty feet, to deflect frosts from April crops between the barriers. Thickets of bamboo trellises covered many a field of young climbing beans and cucumbers. Split bamboo

One of the ornamental bamboos *(Pseudosasa japonica)* used in a Japanese garden near Washington, D.C.

George Taloumis

arches, anchored over rows, supported clear plastic sheeting in temporary cloches for various tender vegetables, primarily tomatoes. Along irrigation ditches, a bulwark of laced-together bamboo poles ran endlessly down each side to prevent banks from washing and crumbling. In some places water spouted from bamboo pipes. Field workers fended off sun and rain with "coolie" hats woven of bamboo.

In many parks and gardens we saw appreciation for ornamental bamboos—small-growing species used for hedges and ground covers, as well as high forms for dense screens and backgrounds. Some of the varieties had colorful yellow and white markings on the green leaf blades.

Bamboo plays a major part in China's celebrated reforestation program. Trees of large size were being moved into street plantings, their root balls secured in that Chinese improvement on burlap—custom-woven, plantable bamboo baskets. For steadying while new roots established, the planted trees were triangularly braced with stout lengths of bamboo, placed to form the hypotenuse linking tree with ground. Often a tree had two or even three such braces.

Ancient trees seemed scarce in China, except in the small temple and pagoda gardens where venerable specimens have been preserved. Lace-bark pines *(Pinus bungeana)* and weeping sophoras are the best remembered of these honored Methuselahs. Where their time-bowed trunks hung earthward precariously, sturdy bamboo props or crutches had been lovingly installed.

Enough of enumeration. Western travelers from Marco Polo onward have marveled often at the myriad uses of bamboo in the Orient. Probably no other plant is put to so many purposes by so many people. Under the definition of horticulture that embraces both the growing and *using* of plants, we must view bamboo as the foundation and the core of Chinese horticulture.

It is the perfect material—light, strong, durable and workable. Best of all, it grows fast—from sprout to maturity in less than a year, and under peak conditions more than forty inches a day. The two species most used economically, *Phyllostachys bambusoides* and *P. pubescens (edulis),* are both native to China, having been there from the start. They and other species are indigenous over much of Asia, a blessing of benevolent nature.

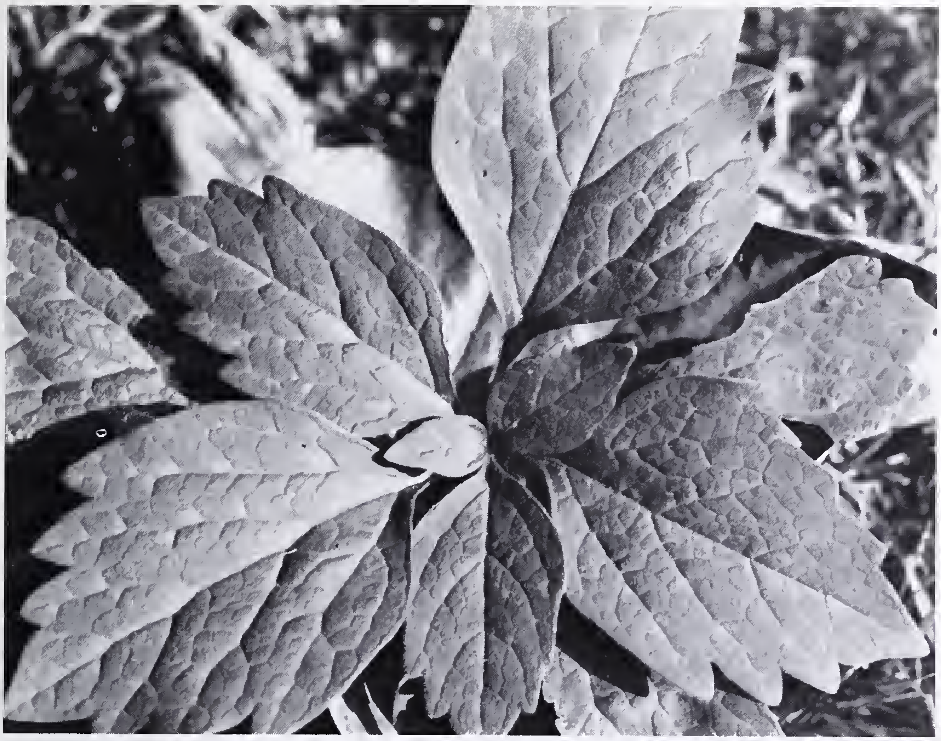
Think what the English might have done, if they had had bamboo. ❧

TAXONOMIC PREGNANCY

Bamboos are plants of romance and mystery. Many mysteries, actually. One of them has to do with their flowering. Bamboos, depending on the species, bloom every 20 to 120 years. All of the bamboo plants of a particular species flower approximately at one time, even if they are young divisions from old plants, or grown in gardens far from their land of origins. After flowering, each plant of the given species dies. Fortunately there is abundant seed production, and the species is thus perpetuated.

This unique flowering phenomenon has caused identification problems. In the July/August issue of *Garden*, Thomas R. Soderstrom, a botanist at the Smithsonian Institution, described a remarkable example of taxonomic pregnancy. Umbrella bamboo, widely grown under the unconfirmed botanical name *Arundinaria murielae*, recently began to flower in gardens all over the world. It is on a 100-year flowering cycle and because it had been discovered in China in the 1880's the flowers had never been studied nor, hence, the plant properly classified. Because flowers are essential for taxonomic classification, this was a century-long puzzle. After studying the flowers of umbrella bamboo, Dr. Soderstrom decided to place the species in a different genus. It is now *Thamnocalamus spathaceus*. ❧

Michael A. Dirr



A little-known ground cover . . .

THE ALLEGHENY PACHYSANDRA

Michael A. Dirr and John H. Alexander, III

Reprinted from Arnoldia
(Arnold Arboretum of Harvard University),
January, 1979

Repetition seems to be the rule with ground covers for the same kinds are used repeatedly and few attempts have been made to educate the public or offer it alternative selections. Purple winter creeper (*Euonymus fortunei* 'Colorata'), English ivy (*Hedera helix*), Japanese pachysandra (*P. terminalis*) and periwinkle (*Vinca minor*) are the dominant offerings and comprise probably fifty to sixty percent of the ground covers used in the East and Midwest. None of these ground covers is without problems, and in recent years Japanese pachysandra has been afflicted with *Volutella pachysandrae*, a fungal pathogen that causes cankers and stem dieback. A severe infestation can devastate an established planting. Controls are available, but often by the time the homeowner recognizes that a problem exists, it is too late for effective treatment. The monoculture of trees (example: American elm) should have taught us something; however, the same type of mistake is being repeated with ground covers.

A Native Pachysandra

An American species, *Pachysandra procumbens,* Allegheny pachysandra, is one of the most handsome plants for ground cover use, yet is seldom seen in gardens or in commerce. This fact has been lamented by other authorities and the species suffers a fate common to other quality plants: entrapment in the confines of an arboretum or botanic garden. Several reasons for the lack of visibility include limited publicity compared to its Japanese cousin, and the purported difficulty of propagation. Division offers a suitable means in the home garden but is excessively slow for commercial purposes.

The plant was discovered by André Michaux in the 1790's and was described in his *Flora Boreali-Americana.* Its range was listed as the western Allegheny mountains; hence the derivation of the common name. Braun noted that the species is found in Kentucky, Tennessee, northern Alabama, Mississippi and northern Florida. The species also occurs in North and South Carolina. Wherry studied native stands from Somerset, Kentucky, south to the Gulf of Mexico. He noted that the plant abounded on rocky slopes, being most at home in woods, but persisted even where trees had been cut and land pastured. The underlying rock was limestone and the soil reaction was circumneutral (around pH 7). According to Wherry, most plants were situated on slopes along streams.

The species is hardy far north of its range and is successfully cultured at the Morton Arboretum, Lisle, Illinois, as well as at Champaign-Urbana, Illinois, where temperatures may reach −20° to −25°F. A planting has been maintained since 1962 at the University of Minnesota Landscape Arboretum where winter lows reach −30°F; however, snow cover is usually constant and affords protection.

The Arnold Arboretum in Jamaica Plain, Massachusetts, has plantings that have not been disturbed since June, 1943. One measures 3 by 4.5 feet and another, 3 by 7 feet. The former is on the east side of the Administration Building while the latter is on the north side and hemmed in by the parking lot and building so it can spread in only two directions. There is no evidence of any disease or insect problems in the plantings. The species' extreme shade tolerance is evidenced by the excellent performance in these locations. Under landscape conditions, a moist, well-drained, organic, slightly acid soil would probably prove optimum. Any plant that increases by rhizomes or underground rootstocks benefits from a loose, friable soil because there is less physical impediment to the expanding structures.

What's It Look Like?

Summer foliage ranges from a grayish- to bluish-green with a slight mottle and does not possess the luster of Japanese pachysandra. The leaves assume a bronze color in the late fall and by winter's termination range from greenish-brown to brown. The foliage is not truly evergreen and may vary from deciduous to semi-evergreen. Leaf retention depends on siting and geographic location. The species forms a handsome carpet that varies from 6 to 10 inches in height. If the foliage deteriorates over winter, abundant new shoots will have developed to form a solid cover by May or June. The leaves are much wider than the Japanese species and display more prominent (coarser) serrations. Although alternate in arrangement, the leaves appear whorled because the nodes are so closely spaced. They range in size from 2- to 3½-inches long and almost as wide.

The flowers are especially attractive and develop in March and April on 2- to 4-inch-long spikes that emanate from the base of the stem. A single stem may have up to three spikes, but one is more common. The position of the flower provides another means of separating the two species, for on Japanese pachysandra the inflorescence is at the top of the stem in the middle of the pseudo-whorl of leaves. The flowers of *P. procumbens* are a purplish- or pinkish-white (stamens may be pink in color) and possess a pleasing fragrance. Unfortunately, if the Allegheny pachysandra is killed to the ground, the flowers will be lost. Even though they are basal, they elongate and partially rise above the foliage which is often flattened by winter weather. The early flowering date couples the species with red maple (*Acer rubrum*) and together they could be considered "harbingers of spring." Fruits are not showy and apparently seldom develop in cultivation.

Propagation difficulties may have limited commercial offerings in the past, but this is no longer a problem. Cuttings of vigorous semi-hardened growth taken in June have rooted readily. In experiments at the Arnold Arboretum, cuttings collected in September rooted no less than eighty percent in eight weeks when placed in sand and perlite under mist. Ten treatments were employed and even the controls rooted, but indolebutyric acid (IBA) and naphthaleneacetic acid (NAA) when applied as dips (pure chemical dissolved in fifty percent ethanol) resulted in one hundred percent rooting and large root systems.

Allegheny pachysandra is an aesthetically functional alternative to the more common ground covers. Ask your local nursery for help in locating plants. The following firms may serve as an alternative if there are no local sources: The Wild Garden, Box 487, Bothell, WA 98011; Brookside Nurseries, 228 Brookside Rd., Darien, CT 06820 (no shipping); Weston Nurseries, E. Main St., Hopkinton, MA 01748 (no shipping). ☙

Higher than prime rib . . .

A RECORD PRICE FOR AN ORNAMENTAL TREE?

Paul L. Swanson

Reprinted from AMERICAN NURSERYMAN,
October 15, 1979

The Brooklyn Botanic Garden's handbook *Dwarf Conifers*, published in 1965, featured Helene M. Bergman as Guest Editor. She and her husband developed an arboretum in Feasterville, Pennsylvania, which they named "Raraflora."

In her discussion of dwarf five-needle pines, Mrs. Bergman included the cultivar 'Bergman' under *Pinus parviflora*, the Japanese white pine. She describes it as: "A spreading, rounded shrub with many leaders of equal size. Leaves 2½ inches long, bluish, twisted. The erect winter buds are up to 1¼ inches long. This seedling shows characteristics of both the Japanese and the Korean white pine. At 15 years, [the shrub] is 17 inches high, 36 inches wide."

When the Bergman arboretum plants were auctioned off in June, 1979, a specimen called *Pinus parviflora* 'Bergman #1' was sold for $13,000. Presumably this is the same specimen Mrs. Bergman mentioned in *Dwarf Conifers*, and the same one listed in the auction catalog as No. 1706. The size the catalog gave was five feet tall and seven feet wide; elsewhere, 4½ feet by 8 feet was given.

The way a measurement is taken could account for the discrepancy. The average width is used instead of the extreme, and ground levels are often uneven.

The auction price is perhaps a record for an ornamental tree. The *Guiness Book of World Records* states, "The highest price ever paid for a tree is $51,000 for a single Starkspur Golden Delicious apple tree from near Yakima, Washington, bought by a nursery in Missouri in 1959." ☙

All photos by author

Deer, oh, deer, what can the answer be?. . .

COPING WITH DEER IN SUBURBAN GARDENS

John Van de Water

The only certain protection against deer is an eight-foot high fence. Anything else is apt to be only partly successful. Obviously, few homeowners are willing to fence themselves in, so alternatives must be considered. But if you live in deer country and want to grow vegetables or nursery stock, a properly fenced-in enclosure is essential.

Deer are a joy to watch, and when the spotted fawns appear in June and July, few can resist a tender feeling for these graceful animals. Yet, where they are abundant, deer are the most destructive pests of gardens, landscape plantings, orchards and nursery stock. Where deer browse, few young shrubs and trees can reach maturity. Buds and twigs are nibbled in winter, new growth is eaten in the spring, and leaves are browsed in the summer. In December, bucks rub bark and break down small trees and shrubs in removing the velvet from their antlers.

Today the deer population is greater

than it has ever been. The National Wildlife Federation estimates that there are over twelve million white-tailed deer in the U.S., most of them in the eastern states (the West has mule deer, another species and by no means as concentrated.) In 1900 the population was about half a million. The increase is from two causes—protection through restricted hunting, and loss of predators. In many suburban areas and parklands, hunting has been eliminated altogether. Predators such as wolves, mountain lions and bobcats have fled before expanding civilization.

Creatures of Habit

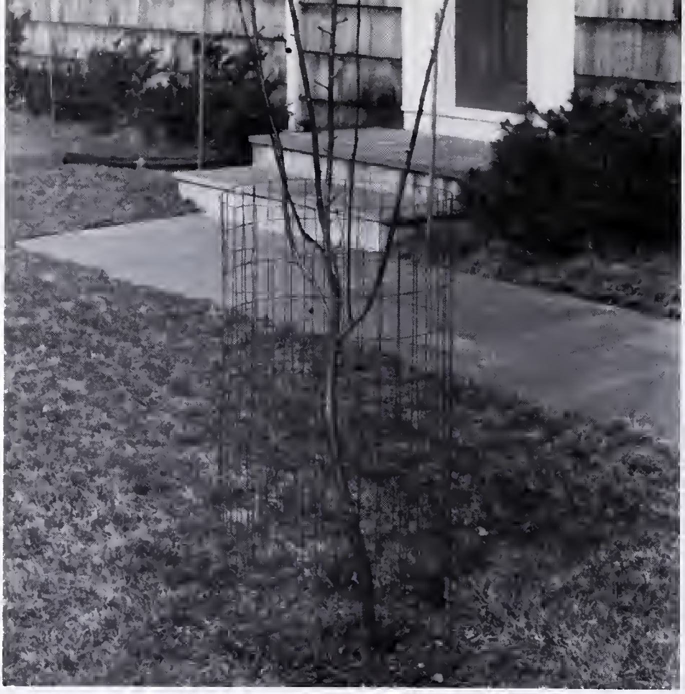
The result is many more deer in suburban and semi-rural areas. Road building and residential development, which quickly scare off predators, do not deter deer until they approach urban density. Deer are creatures of habit. We have seen roads built through woodland where deer congregate. They still congregate, only now alongside the road, or sometimes in the middle. We built our house on a deer run, but the deer continue to walk by daily and would eat the foundation planting to the ground in winter were it not fenced in. Yet only a thousand feet away, neighbors can grow what they want, and only an occasional stray deer will nibble at their yews and mountain-laurels.

Feeding habits are equally invariable. Deer engage in diurnal migration. They spend the day in one area, the night in another. At dawn and dusk they walk, usually in groups, from one to the other. They feed all along the way. Not much is eaten of any one plant at any one time, but as they take the same route each day, many shrubs and trees never get a chance to grow up.

Being browsing animals, deer have a diet primarily of twigs, buds and leaves. They also eat grass (and young shoots of vegetables, flowers and bulbs) but cannot get sufficient nourishment from it alone. Like cows, deer are ruminants, which means they have several pouches ahead of the stomach where food is deposited and pre-digested, to be regurgitated and chewed as cud at leisure. The pouches are the sites of a specific intestinal "flora," bacteria that aid in the digestion of woody plant material. The type of bacteria depends on the food consumed, so deer cannot change suddenly from one kind of diet to another. That is why any effort to feed deer grain or hay in winter in the hope of preventing browsing on trees and shrubs is doomed to failure. Deer have died from starvation with their stomachs full of grain.

When hungry, deer will eat almost any kind of tree and shrub, but when food is plentiful they have definite preferences. In bad weather when deer can't migrate, the wooded areas where they congregate will be stripped of everything edible as

Opposite: deer migrate at dawn and dusk. Plants along the path are browsed to the point were few can survive. Right: dogwood with antler damage.



Two-foot-wide cages protect young trees and shrubs from browsing by deer. Foundation plantings have to be fenced to prevent damage.

high as they can reach—six feet standing on their hind legs. Trees have survived in these areas only because they matured before the deer population exploded.

Gourmet Fare

Among preferred foods are soft-needled and broad-leaved evergreens. Yew, hemlock, juniper, fir, spruce, larch, false-cypress and white pine are especially favored. Conifers with stiff needles such as Austrian and red pines (*Pinus nigra, P. resinosa*), are more likely to be left alone. Yews, spreading junipers and small hemlocks can be eaten to the ground in one winter.

Evergreen azaleas and mountain-laurel (*Kalmia latifolia*) are also favored winter food, and rhododendrons get their share of attention. Although laurel and rhododendron are reputedly poisonous, this belief has not deterred deer from feeding on them regularly. Japanese holly (*Ilex crenata*) is another favorite, as are the various kinds of evergreen euonymus. Many evergreen ground covers, including pachysandra and periwinkle, are extremely vulnerable and can generally not be grown in deer country. Boxwood, on the other hand, seems completely safe.

Among deciduous shrubs most heavily attacked here in New Jersey are pussy willow, euonymus (especially *E. europaea* and *alata* 'Compacta') and several viburnums. Of the viburnums, the native arrowwood (*V. dentatum*) is browsed very heavily. So is the *opulus* group, which includes not only the tall and dwarf *opulus* varieties, but also *trilobum* and *sargentii*. Surprisingly, other viburnums—*sieboldii, plicatum, wrightii, dilatatum, rhytidophyllum* and *carlesii*—are pretty much ignored.

Roses don't stand much of a chance because the young shoots are browsed before they develop thorns. New shoots of deciduous azaleas are eaten in the spring, but they have a chance at survival if the leaves manage to mature and become hairy.

The spiny leaves of American and English hollies (*Ilex opaca, I. aquifolium*) are of no interest to deer, but the deciduous winterberry (*I. verticillata*), with its soft foliage, gets all the more attention. The shrub is eaten continuously and it is impossible to grow one to maturity if deer can get at it. Thorny plants are generally safe, especially barberry, firethorn and hawthorn.

Usually Spared

Some plants are virtually deer-proof, and these are the ones to grow where deer are a problem. However, nothing is certain. Some plants are immune to deer in one location or during one year, yet are browsed heavily elsewhere or at another time. Flowering dogwood (*Cornus florida*) flourishes in our area. Although the young trees are nibbled, not enough is taken off to make any difference. When bucks rub the bark in the fall, the trees don't die. Instead, the following spring they put out a number of shoots below the rubbed area. They are then safe because bucks won't rub bushy plants in which antlers might get entangled.

Other species in the *Cornus* genus are also mostly ignored. Among these are *C. mas, kousa, sericea, amomum* and *racemosa*. Forsythia, weigela and privet can be grown without difficulty. Cotoneasters are also left alone, although the ground-hugging types are sometimes lightly browsed in winter. Lilacs seem to be moderately attractive and are eaten only sporadically, mainly young shoots in spring. Birch trees and red maple (*Acer rubrum*) are ignored, but Japanese maple (*A. palmatum*) doesn't stand a chance. Also virtually deer-proof are blueberries, magnolias and stewartias.

Although low-growing shrubs are always ready targets, large shrubs become less vulnerable to browsing as they mature. One reason is that when they reach a certain size they can afford to lose a few leaves and twigs. Another is that they become too large for the deer to reach. The lower parts, however, can be thoroughly denuded. A few plants grow so fast that they outpace any damage deer can do. Typical ones are autumn-olive (*Elaeagnus umbellata*), tatarian and Morrow honeysuckles (*Lonicera tatarica, L. morrowii*) and multiflora rose (*Rosa multiflora*). Of course, none of these are plants for the average home grounds, and multiflora rose shouldn't be grown anywhere.

How to Cope

Protection against deer takes two forms—physical deterrents and repellents. Physical deterrents are simply fences and cages. An eight-foot fence is needed if deer are to be kept out of a large area—they will jump over anything lower. Small areas near a building can be protected with a four-foot fence, for deer usually won't jump into small enclosures. (That they sometimes do is a hazard; they have even been known to jump through picture windows.) New shrubs and trees should be protected with cages four feet high and eighteen to twenty-four inches in diameter.

Young trees are especially vulnerable to antler rubbing, for bucks prefer to rub trunks no more than an inch or two thick. Once four inches thick, trunks can be safely left exposed. Small trees with three or four feet of clear trunk can be protected with a wire cage six-inches wide. An even simpler device is a pipe sunk into the ground right next to the trunk. With three or four feet of pipe above

Strips of burlap soaked in bone oil keep deer away. To remain effective, treatment must be repeated each month.

ground, rubbing is stopped completely.

Whether electric fences can keep deer at bay is subject to some disagreement, but in many cases they do work. A fence with two wires, one eighteen inches and the other thirty-six inches above the ground, can be effective. Although deer could easily jump over such a fence, they prefer to go under, and in doing so will naturally touch the lower wire. Also, they often nuzzle an obstacle and with the upper wire at head height they are quickly stopped. Some horticulturists suggest placing a third wire about eighteen inches inside the other two and at a level half way between them. The theory is that if a deer does stick its head between the two outside wires, it will encounter the inner one.

All sorts of repellents have been suggested to prevent deer damage—including moth balls and dried blood—but the most common ones are Thiram, bone oil, and two recent discoveries—Tabasco sauce and hair balls. No repellent works absolutely. They work best in summer when the plants are in full leaf and there is lots of food. They also depend on deer pressure; the more deer, the less effective they are.

Thiram, actually a fungicide, and Tabasco sauce repel by taste. The sauce requires only two tablespoons per gallon of water with a sticker added. Thiram is very sticky and hard to spray; it is best applied with warm water. Both are sprayed directly on the plants. To be effective, the treatment has to be repeated every two weeks.

Bone oil kills plants if sprayed directly on the leaves, so it is sprayed on the ground around trees and shrubs, or in a ten-foot wide strip around the area to be protected. It repels by odor, which many people also find objectionable. Spraying has to be done once a month to be effective. In winter it persists even less.

Repeated spraying can be a nuisance, especially if many plants are involved. It has to be done when the temperature is above 40°F, for at low temperatures the materials won't mix, become thick, or don't mist properly. That eliminates their use in winter.

When first announced, hair balls were supposed to be the final answer. They consist of small net bags filled with human hair, which means you have to make a deal with your barber. However, they seem to be effective only when deer pressure is low. They work hardly at all in winter, for odors are not volatilized at low temperatures, so they simply don't smell.

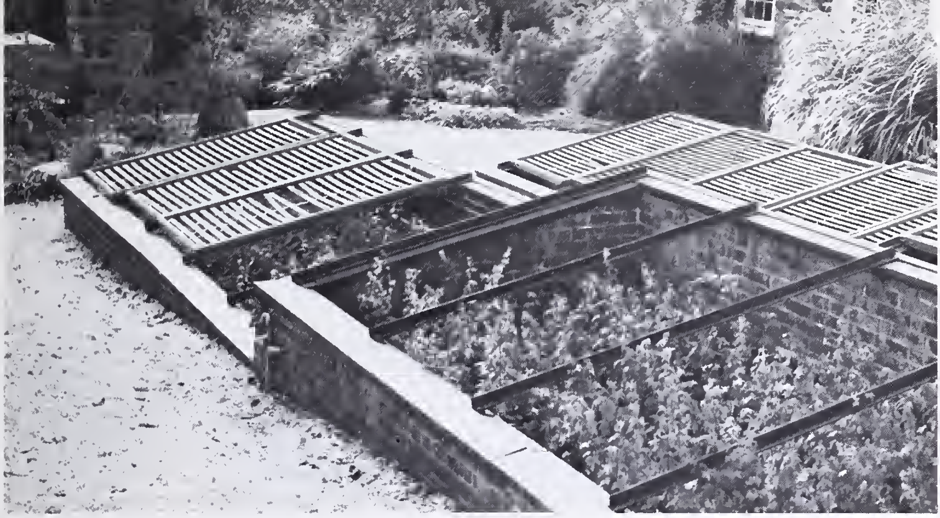
Our own experience has shown that hot sauce is good for short periods of time, and bone oil is effective if applied often enough. Strips of burlap soaked in a solution of half bone oil and half water and hung on stakes next to young plants have been effective in spring and summer. They have to be redipped every six weeks or so. To protect large plants, they have to be placed about every foot or two, an unattractive sight that limits their use around the house or garden. Sometimes nothing seems to work and it is only the deer's whim that lets anything survive. Where it really matters, we depend on fences and cages. ✤

THANKS, LADYBUG

Reprinted from
The Dawes Arboretum Newsletter,
June, 1979

We read somewhere that, under ideal conditions, one female aphid could, from April until October, produce over one septillion offspring.

Using aphids of 1/16 inch long, 1/32 inch wide, and 1/32 inch thick (some are larger), we figure that's enough to cover the entire earth to a depth of four feet, eight inches! ✤



An old structure comes
to new life in the 1980's . . .

THE COLD FRAME

Stuart Simon

In the long history of gardening a wide variety of garden structures have been developed to satisfy the environmental needs of our plants. Most people are familiar with the more prominent and prestigious types such as conservatories, greenhouses and lath houses. Fewer have discovered the wonderful qualities of the Cinderella of garden structures, the cold frame. However, this is bound to change because, in these energy-conscious days, the simple cold frame can supply many of the same benefits for the home gardener as the energy-expensive greenhouse.

Despite wide variations in appearance, a cold frame is a structure of wood, metal, brick or similar sturdy material, placed on the surface of the ground and provided with a transparent cover. Its basic function is to afford specific types of protection against the elements, depending on the season and the use.

Site

Before building a cold frame decide on the proper location. This will depend on the types of plants to be grown as well as the use to which the frame will be put. Terrain and direction of the sun are factors. Cold frames should be situated on flat, well-drained land, away from tall structures from which water or icicles may drip to damage the plants or the frame.

The position of the frame in relation to the sun depends on how the frame will be used. For maximum growth of annuals or vegetables in the spring, a south-facing position is best. For storing dormant plants over the winter without the problem of fluctuating temperatures, a north-facing situation is ideal. In general, however, a south or southeast position is the most useful. A final consideration is protection from winter winds so equable conditions in the frame can be maintained. This can be afforded by a house, hedge or fence, or by a high hill or woods.

Excavation and Foundation

It is possible to construct a frame completely above ground, or to excavate to a certain depth, subsequently building a foundation and placing the frame over it. The advantage of placing the frame over the ground, without excavating, is ease of construction and portability. This frame is preferably made of wood because it retains a more even temperature. Such a frame is often supported by a brick base, one brick deep to prevent the wood from rotting.

A pit house can be a versatile extension of the cold frame.

Another type of portable frame uses bent electrical conduit and polyethylene plastic sheeting. The disadvantages of portable cold frames are the lack of sufficient insulation, especially in the North, and, frequently, inadequate drainage.

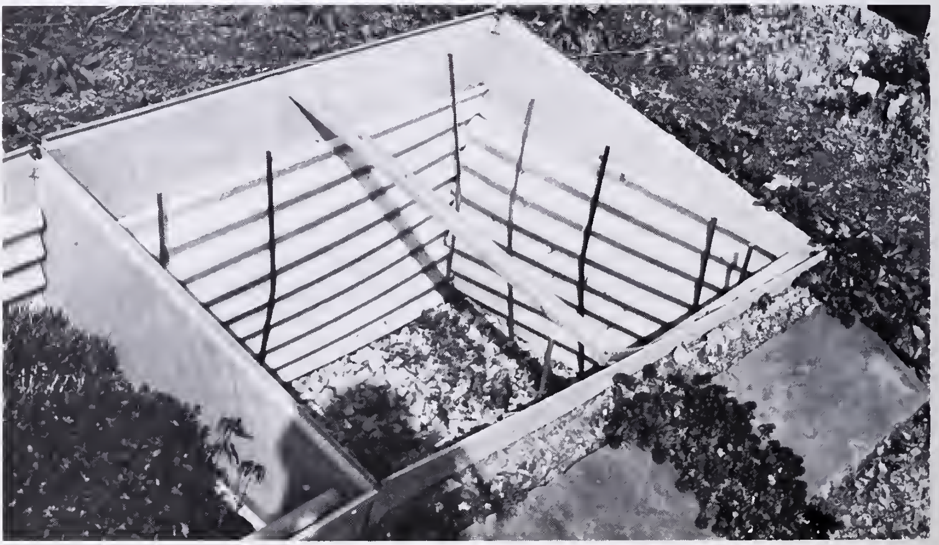
For greatest insulation and versatility an excavation should be made two to three feet in depth, deeper if sapling trees or shrubs of any size will be placed in the frame. At the bottom of the excavation six inches of cinders, crock or similar drainage material should be used.

Not only does an excavation provide considerable insulation, particularly if it is below the frost line, but a foundation of brick, cinder blocks or poured concrete can also contribute to this insulation. Cinder block is perhaps the easiest of the three materials to work with, but a poured concrete foundation can be made by using a wooden frame parallel to and four inches away from the walls of the excavation and pouring the concrete into the space between the wall and the wooden frame. This frame should be removed after the concrete hardens. The foundation should extend to the bottom of the excavation.

Frame and Sash

The actual frame is that structure which

An inexpensive, home-made cold frame.



All photos by Dee Peck

A simple cold frame with fiberglass top. Note that the inside walls are painted white to reflect light.

sits on top of the foundation or, if no foundation is used, directly upon the ground. Frames can be made of the same material as the foundation or of wood. Wood is the easiest material to use, but a cinder block or concrete frame is more durable and will provide better insulation.

Whatever material is employed, the frame looks like a bottomless box. The rear of this box is normally higher by 9-12 inches than the front, and the front is usually 9-12 inches high from the foundation. This slope from back to front permits rain to drain from the structure and facilitates snow removal. On top of the frame there should be placed a wooden strip to hold the sash.

The sash is the cover of the cold frame. Traditionally the sash is 3′ x 6′ and made of glass. Standard sash looks much like a window with small panes of glass—and is often just old storm sash. These panes, called lights, run on an angle to prevent water from standing on the frame. Other lighter transparent materials can be substituted for glass. Some gardeners use translucent ribbed fiberglass in a wooden frame. Although this material reduces the amount of light reaching the plants, the ease of construction and low cost compensate. If fiberglass is used, the corrugated ripples should run from top to bottom, not from side to side. The sash should be measured snugly into the wooden strips on the frame to create a weathertight fit.

It is possible to extend the size of the cold frame by fitting several sash side by side. For example, a double cold frame may be constructed by making a foundation 6′ x 6′ covered by two 3′ x 6′ sash. Triple and quadruple cold frames may be similarly constructed. If such a plan is used, a wooden bar, which fits into slots on the top and bottom of the frame, should be used to hold the sides of the sash in place. This bar should be movable so the sash can be lifted for easy access to the frame. Sash dimensions can be varied to suit the individual gardener's needs, but the sash size and the frame size must match.

Uses

Cold frames have a variety of uses and can be put to work throughout the year.

Spring. 1) Early sowing of vegetables and annual seeds. Get a head start by taking advantage of the warmth that builds up in early spring in the frames. Seeds of vegetables and annuals can be sown in March and April, as the days are becoming longer, and will germinate and develop into sturdy plants. These can then be set into the garden at the proper planting time.

2) Forcing. Woody plants and herbaceous perennials that normally flower later can be forced into early bloom by placing them into the cold frame in early spring.

3) Growing early-blooming flowers. Pansies and other half-hardy perennials or biennials can be held over winter in a cold

frame to start into growth and bloom earlier than normal.

Summer. Too few gardeners use their cold frames in the summer, but this season offers many possibilities.

1) Propagation. Upon cleaning out the frame after winter and spring use, cuttings can be placed in it and seeds sown. The sash should be removed and, if shade is desired, a lath frame can be constructed, or a house screen can provide shade, as well as protection from heavy rain.

2) Protection of shade plants. Cold frames can be used not only to protect plants from too much cold in winter, but also too much sun and heat in summer. A deeper frame will insulate plants needing cooler summers from excess heat and a screen or lath atop the frame will protect the plant from excess sun. This is especially valuable for holding house plants over in early summer, before they are placed in their summer home.

Fall. 1) Late crops. Late-maturing fall crops such as lettuce, endive, Chinese cabbage and celery can be kept frost-free or nearly so in a deep frame and harvested into December, sometimes later. Also, seeds of these plants can be sown in a cold-frame propagation bed in later summer (under lath) and kept in the frame for fall harvest.

Winter. The traditional use of the cold frame is during this season.

1) Protection of young plants. Young plants from the propagation bed can be over-wintered in the frame without the danger of heaving they would be subjected to in the garden.

2) Storage of certain alpines and succulents. Protecting them in a cold frame can provide the dry winter conditions they need, though they may be fully hardy.

3) Cold storage. Hardy plants that we wish to maintain in a dormant condition over the winter can be placed in the cold frame. If the sash is covered with an opaque cover such as plastic bags covered with leaves, tarpaulins or similar materials, after the first hard frost, the plants will remain dormant until spring. The method is also useful for certain chrysanthemums, delphiniums and other perennials of undependable hardiness in the garden.

Maintenance

The key to successful cold frame operation is in its proper management. Contrary to popular belief, cold frames are not low-care structures.

Here are some points to remember:

Check the temperature in the frame in winter, spring and fall. On sunny days heat builds up tremendously in a closed frame—even on cold days. The sash must be properly opened and closed to reduce the heat to desired levels.

Keep the frame well ventilated to reduce fungus problems—again by regulation of the sash.

To reduce pests and diseases keep the frame clean. Summer is a good time for a thorough cleaning of the frame.

Shading may be necessary at any time of year to prevent damage to the plants. Wood lath, cheesecloth, or window screen can reduce the intensity of the sun.

FOR BUSY GARDENERS

Wouldn't it be nice if there were some automatic way to control the opening and closing of the cold frame on sunny winter or spring days when heat builds up inside? Well, in our mechanized age, such a convenience exists. George W. Park Seed Co., Greenwood, SC 29647 offers two products for automatically regulating temperature.

The Vent O'Matic cold frame consists of a complete above-ground unit which has a sash that is opened and closed by a thermostatic device. This device automatically opens the sash when the inside temperature reaches 72°F and closes the sash at 68°. If you already have a cold frame or plan to build your own, Park has the Solar Vent Greenhouse Window Opener. This solar-powered device automatically opens and closes the sash, as does the Vent O'Matic device, but may be attached directly to your cold frame.

M. Joyner

MEADOW GARDENING

Frederick McGourty, Jr.

Meadow gardening is gradually coming into its own, especially in parts of the country where brush does not quickly invade fields. It has not gained many followers in suburbia, where trim and tidy lawns reign, but a number of people elsewhere like the natural appearance it creates. Some maintenance is indeed required, namely mowing once a year in autumn and culling tree and shrub seedlings, as well as curbing certain aggressive weeds by hand or spot treatment with herbicides. Perennial wild flowers must be rough-and-tumble sorts to cope with the competition, and they appreciate its absence the first year or two until established.

Success depends in part on where you live and how much effort you are willing to put in. Meadow gardening is not a major task on the relatively dry and windy American prairie and its perimeter, where weed trees, let alone trees at all, have a difficult time becoming established. In the eastern states and the Pacific Northwest, which are areas of essentially high rainfall, woody growth, *i.e.*, the forest, is the natural course. There, the meadow gardener must work harder.

Meadow gardening is not everyone's cup of tea, but it may be yours, especially as the conservation of petroleum-based products used in other forms of horticulture becomes a concern in the 1980's. Before launching a project, it helps first to see an area which has been given over to prairie "reconstitution" for some time, as the one at the University of Wisconsin in

Above, a New England meadow, previously the domain of dairy herds, can be kept in prime condition by yearly mowing and roguing-out of vigorous volunteer shrubs and trees.

Madison, which is at its prettiest in summer. Books help too, particularly Warren G. Kenfield's *The Wild Gardener in the Wild Landscape* (Hafner-Macmillan) and the Connecticut Arboretum (New London) bulletin *Energy Conservation on the Homegrounds—The Role of Naturalistic Landscaping,* edited by William A. Niering and Richard H. Goodwin. However, meadow gardening is a rather young art (and even younger science). Also, each site has its own character, possibilities and problems, and there are many fine points that have to be learned by experience. This is as it should be, for the astute observer can make a valuable contribution to our knowledge of this field.

Main Points

Surely one of them is the advice to start small. Many worthwhile projects are abandoned because the energy of a gardener in August does not match his aspirations of the preceding April. Don't plan to change a field or home grounds all at one time. Choose a limited area, say a distant portion of the backyard that had been given to lawn, and keep the mower away from it until autumn. This will at least let you know what you have.

There will be pleasant surprises, perhaps some asters or yarrow you never knew were there. However, plants with a very great potential for spreading, such as bindweed and Canada thistle, should be repeatedly cropped by hand or spot-treated with a herbicide. A light but firm yank will take care of first-year tree or shrub seedlings. Don't delay pulling them, especially oaks.

Stable plant communities, such as they are, are made essentially by nature, not man. Dig up a small patch of earth and before much time has passed all sorts of plants, many unwanted, many unknown, will appear—unless you live in a semi-arid part of the country or on a gravel bank. What the meadow gardener is trying to do is to establish a desirable, fairly stable plant community, one with aesthetic appeal and requiring, over the long run, moderately low maintenance. It is an uphill battle in most areas, a struggle where the bulldozer is no help, and even some old gardening tenets must be cast aside.

A cardinal principle is to disturb the soil no more than is necessary. This does not mean that you simply go out and scatter a few seeds from a packet of wild flowers, then return to the porch, eat a Granola bar, and watch the plants grow. Nature doesn't work this way, at least not very efficiently, and you don't, either.

Some soil disruption and plant tending will be necessary if you raise plants from seed on the site. If young plants are set out on the site in spring, they will also likely need care, especially watering, the first year. A 2-3-inch deep mulch of wood chips, pine needles or other organic material around them conserves moisture and discourages weeds, but keep it away from plant crowns so as to minimize the chance of root rot. Bear in mind, too, that the majority of plants require well drained soil. (For exceptions see BBG Handbook on *Perennials and Their Uses.*)

Study the periphery of the site, whether the site is a meadow, small field or lawn-to-be-abandoned, for this is where trouble is apt to originate, at least in the normally wooded parts of the country. If there are ash, maples or oaks, a good number of seedlings can be expected. Some individual trees are much more prolific seeders than others of the same species, in part because their flowers may be all or mostly pistillate (female). These very trees will be troublesome over the years, and thought might best be given to their removal in the beginning, if the periphery is wooded and the trees won't be missed. Deciduous trees usually sprout from the base when cut, but an effective if slow method of making sure the roots die is to girdle the trunk with an ax.

Black cherry *(Prunus serotina)* and choke cherry *(P. virginiana)*, which are spread by wildlife, especially along stone walls, are also problem trees. Aggressors among shrubs vary from one part of the country to another; arrow-wood viburnum *(V. dentatum)* and meadowsweet *(Spiraea latifolia)* may be bothersome in the East, ocean spray *(Holodiscus discolor)* in the Northwest. Brushkillers applied to the cut stumps of some of these shrubs are not always effective. If there are but small colonies, resort to a pick, or cut the shrubs to the ground and spread

Lorraine Barstow

Wild columbine *(Aquilegia canadensis)*, a native of North America, is a reliable bloomer once established.

black plastic over the base, adding pine needles or nearby duff for aesthetics.

A dense stand of evergreen conifers adjacent to a meadow is very helpful, for their shade will discourage undergrowth that might eventually invade the meadow. In turn, if the conifers seed themselves into the meadow, a yearly mowing will control them, since very few kinds are capable of sprouting from the roots when cut.

Another stabilization technique is to encourage natural ground covers such as hay-scented or New York ferns along the periphery. Once established, their tightly knit root systems prevent virtually any other kind of plant from taking hold. The same is true, but only in a sunny borderland, of certain goldenrods, *e.g., Solidago rugosa.* Study the plants in your area which in nature form large clumps and keep other plants out. These can be big savers if you put them to work for you.

A Few Plants to Try

The range of appropriate plants for a horticultural meadow is wide, and it varies according to the part of the country. Some of the best, including chicory and Queen Anne's lace, which make a lovely combination, are not even native to America. The following list is restricted to indigenous species of perennials. There are many others that should be tried.

Amsonia tabernaemontana
Anaphalis margaritacea
Aquilegia canadensis
Asclepias tuberosa
Aster sp.
Baptisia australis
Cassia marilandica
Chelone sp.
Coreopsis sp.
Echinacea purpurea
Eupatorium sp.
Filipendula rubra
Gentiana andrewsii
Helianthus tuberosus
Helenium autumnale
Heliopsis sp.
Iris versicolor
Lysimachia sp.
Monarda didyma
Monarda fistulosa
Oenothera tetragona
Physostegia virginiana
Ratibida pinnata
Rudbeckia sp.
Solidago sp.
Thermopsis caroliniana
Vernonia noveboracensis

Should old assumptions be forgot?. . .

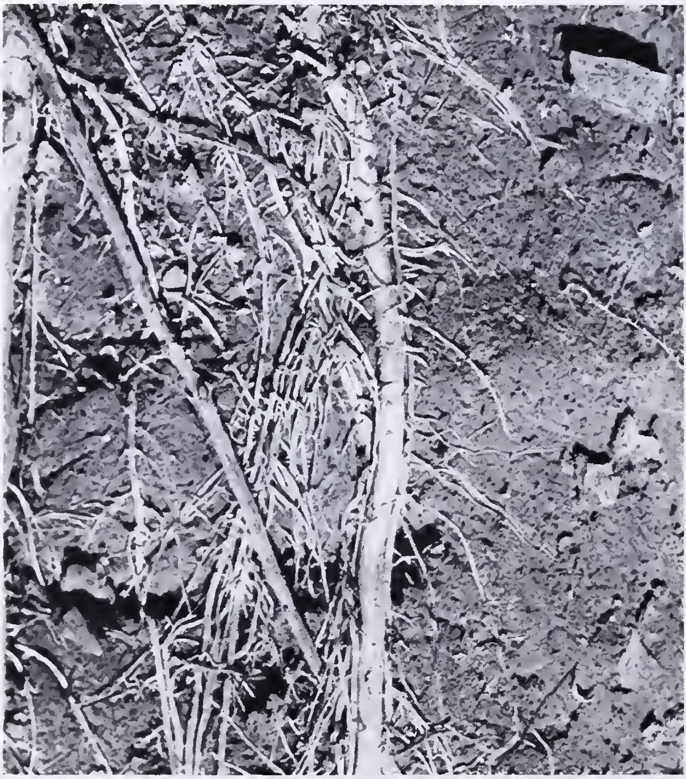
FACTORS AFFECTING THE ESTABLISHMENT OF URBAN TREES

Carl E. Whitcomb

Adapted from JOURNAL OF ARBORICULTURE, October, 1979

Many techniques to aid the establishment of newly planted trees have been proposed. Adding soil amendments to the planting hole, pruning back the top before or immediately following planting and using black plastic beneath mulches to conserve moisture are examples of widely publicized "helpful" planting techniques. Unfortunately, little or no data can be found to support these practices.

Soil amendments, especially peat moss, have been widely promoted as the magic ingredients to mix with backfill soil when planting a new tree or shrub. In recent years, bags of ground pine bark with many "helpful" hints described in detail



Author

Young trees were severely checked in their root development when ground pine bark was used as a soil amendment. There is virtually no root penetration beyond the amended area.

on the bag have filled the retail garden centers. Because of the wide variation in recommended rates, studies were done to determine the optimum amount of soil amendments to add. Soil amendments were peat, vermiculite, sand or ground pine bark at 0, 10, 20, 30, 40 and 50 percent by volume in the backfill around both bareroot and container-grown trees and shrubs. Soil types studied varied from very sandy to a good clay loam to a sterile subsoil clay in a new housing development. Results of five studies showed the optimum amount of soil amendment to add was none. Results were very consistent on all soils with all the species used.

Close inspection of the root development showed a proliferation of roots in the amended soil but few roots extended into the surrounding soil. Ground pine bark was very detrimental to seedlings of silver maple (*Acer saccharinum*). When 40 percent pine bark was mixed with a clay loam soil, trees were stunted compared to trees where no soil amendment was used. Subsequent studies showed that additional nitrogen fertilizer could only partly overcome the detrimental effect of the decomposing bark.

Mulching Tests

Mulching has long been a standard gardening practice. However, the practice of placing black polyethylene beneath the mulch to conserve more moisture and serve as a barrier to weeds should be questioned. A study was designed to determine effects of no mulch, pine bark mulch (2 inches deep) or pine bark mulch with plastic beneath three levels of fertilizer (0, 2 and 4 pounds of nitrogen per 1000 square feet) with each treatment. Sawtooth oak (*Quercus acutissima*), Chinese pistache (*Pistacia chinensis*), Pfitzer juniper (*Juniperus chinensis* 'Pfitzeriana'), and Burford holly (*Ilex cornuta* 'Burfordii') were used as test plants.

The first summer was very dry and no irrigating was done. Plants with both mulch treatments increased in growth as fertilizer level increased. By contrast, those plants with no mulch showed no benefit from the fertilizer. The following winter 96 percent of the pistache trees with black plastic beneath the mulch were killed back to the mulch surface, while trees in other treatments were not damaged. Fertilizer level had little effect on winter injury.

As the remaining trees and shrubs grew larger, no further direct damage occurred. However, after three growing seasons, plants with mulch alone were largest, followed by mulch plus plastic, while those with no mulch were smallest.

Plastic restricted the root development of all plants and did not provide additional weed control benefits. Roots developed in a thin layer beneath the plastic.

Effect of Grass

Grass competition with newly planted trees can reduce root and top development and, in some cases, survival. When common Kentucky bluegrass (*Poa pratensis*) was established after either a silver maple or honey locust (*Gleditsia triacanthos* 'Shademaster') was planted, root development was restricted as much as 68 percent when compared to root development where no grass was present. Later studies with U-3 bermudagrass and Japanese black pine (*Pinus thunbergiana*) showed that a clear area 30 inches by 30 inches around a newly planted tree was sufficient to prevent stunting by the grass for two growing seasons. Additional fertilizer broadcast during the dormant period and the growing season failed to lessen the competitive effect of the grass.

Spare the Shears

The practice of cutting back the tops of newly planted trees is firmly entrenched in the nursery trade. This is probably based on the theory that in most transplanting operations considerable roots are lost and the top should be reduced to compensate for that loss. In the process of conducting numerous weed control studies with field nursery stock, some dormant, bareroot trees were cut back and others were not. It became apparent, at least with some species, that pruning of the top at transplant time was not necessary. To study this further an experiment was designed with six species of dormant, bareroot trees—redbud (*Cercis canadensis*) Bradford pear (*Pyrus calleryana* 'Bradford'), pin oak (*Quercus palustris*), Hopa crab-apple (*Malus* 'Hopa'), green ash (*Fraxinus pennsylvanica*) and Kwanzan cherry (*Prunus serrulata* 'Kwanzan'). Treatments were 0, 15, 30 or 45 percent removal of the top immediately following spring planting with fertilizer (4 pounds of nitrogen per 1000 square feet) or without fertilizer applied at planting time.

All trees were six to eight feet tall when the experiment was started. All trees were watered twice following transplanting with no further watering until the soil became very dry in mid-August. Nearly all trees survived and no benefit from pruning back the top following transplanting could be detected. By contrast, trees pruned back 30 or 45 percent did not have a growth form typical of the species and excessive basal sucker growth occurred on Bradford pear and Hopa crab apple. The high rate of fertilizer applied at planting time was not detrimental even though the soil became very dry.

It appears that the intact crown of the tree plays a more beneficial role in carbohydrate production, auxin release and subsequent root regeneration than in transpiring water resulting in moisture stress.

Conclusion

Based on these studies the following practices are recommended: 1) use no soil amendments when planting, 2) use the materials that might have been used as a soil amendment, *e.g.*, pine bark, as a mulch instead, 3) do not place plastic beneath the mulch, 4) keep grass away from newly planted trees to reduce competition, 5) do not prune back the top of bareroot or balled in burlap (B&B) trees when transplanting except to remove broken or damaged leaves or correct structural weaknesses and, 6) fertilize the tree on the soil surface as soon as planting is complete and mulch is in place. Benefits from the fertilizer will not be noticeable on most species until the second or third growing season but nitrogen, at least, should be applied to most urban soils.

We agree with Dr. Whitcomb but with certain qualifications:

1. *The use of no soil amendments when planting.*
   Often, in city plantings, one is confronted with a "soil mixture" of stones, ashes, broken bottles, rubble, and other debris. In such a case, the preparation of a suitable soil mixture placed in a *large* planting hole to allow for future growth of the root system, would be a necessity.
2. *Materials that might have been used as a soil amendment to be used as a mulch instead.*
   Certain soil amendment materials do not necessarily make a good mulch. Peat moss, for instance, while beneficial as a soil amendment, will "cake" when used as a mulch and thus becomes a poor insulator as well as having a tendency in its dry state to shed water rather then to absorb it.
3. *The pruning back of balled and burlapped or bare-root trees at the time of planting.*
   Aside from removing damaged branches, there is general agreement, *with certain reservations*, that further reduction of the branch system of a plant is not necessary at the time of transplanting. These reservations concern instances where the plant is bearing foliage when being transplanted. If the root ball of a plant is broken in handling, with the loss of a considerable portion of the root system, it is advisable to reduce the shoot system of the plant proportionately. Also, on those occasions when it is necessary to dig and transplant a tree or shrub that is in full leaf (an operation which admittedly is not advisable if it can be avoided), some loss of the root system will be incurred. Here, again, it would be advisable to trim the leaf area of the plant.

—Robert S. Tomson

The rich heritage of . . .

SOME OUTSTANDING ENGLISH GARDENS

Thomas A. Fretz

During the summer of 1978 I had the opportunity to take ten undergraduate students from Ohio State University on a study tour of the gardens of Great Britain. Over a four-week period we were able to experience firsthand the reverence and respect which the English people have for their rich botanic heritage and history.

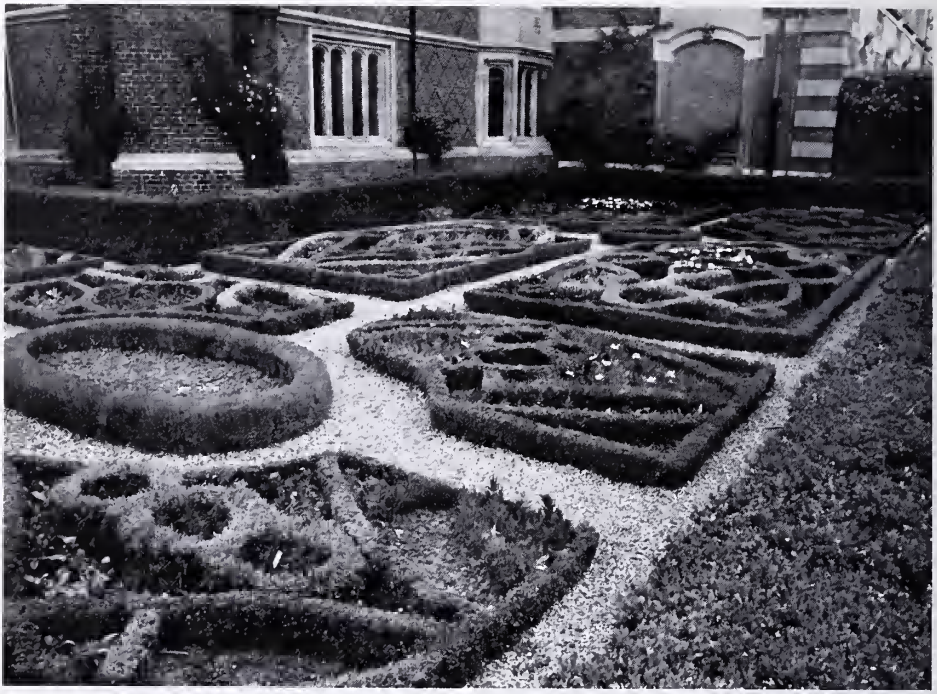
Obviously before leaving on such a trip we all had preconceived notions of what constituted an English garden. Even the definition of a garden according to Webster, "a piece of ground for the cultivation of herbs, fruits, flowers and vegetables," is woefully inadequate in describing the English garden scene. Upon investigation one finds, in addition to the public park, two major forms of gardens in England, those that are constructed and viewed as a "grand garden" and those considered in the strictest sense as botanic gardens or arboreta.

Of the gardens developed in the Grand Style, those at Hampton Court, Blenheim Palace and Chatsworth certainly rank on a scale equal to the great French formal gardens of Versailles and Vaux-le-Vicomte, and any visitor should certainly take the time to visit these.

During this century several "grand gardens" have been created of which the most notable are Bodnant, Nymans, Sissinghurst and Hidcote. All attempt to blend the architectural style of existing structures together with the tasteful display of plants. To keep with the Grand Style, these gardens all also have areas set aside where plants dominate the garden, other areas where the architecture is dominant and, finally, areas where there are great vistas.

ENGLISH GARDENS

Garden Style	Location and Features
Medieval (Before 1530) Typically a cloistered monastery courtyard with paths dividing simple beds of turf. Usually with a herb garden and fish pond nearby.	*Newstead Abbey*, Nottinghamshire. Sunken pool, Japanese garden.
Tudor (1530-1560) No complete Tudor gardens exist in Great Britain today, but remaining features can be found in several locations. The basic features generally include a mount with a pavilion on the summit, the maze, fountains and the knot-garden.	*Hampton Court*, London. Knot garden, maze, parterres.
Elizabethan (1560-1610) Little or nothing remains of the original Elizabethan gardens. Designs are similar to a Tudor garden, but on a larger scale.	*Hampton Court*, London. Knot garden, maze, parterres. *Hardwick Hall*, Derbyshire. Herb garden, rose borders. *New Place*, Warwickshire. Knot garden.
Jacobean (1610-1660) Similar to gardens of the Tudor and Elizabethan periods, only larger and simpler. Mounts and carved beasts no long featured. The period showed an increased use of greenhouses and orangeries for tender plants.	*Hatfield House*, Hertfordshire. Parterre, rose borders, woodland garden. *Packwood*, Warwickshire. Topiary, sunken garden. *Queens Garden at Kew*, London. Herb garden, parterre.


All photos by author

The Knot Garden at Hampton Court Palace.

French (1660-1730) A view over the elaborate parterres and lakes is central to the French style. Also, the extensive use of radiating avenues of trees, along with abundant statuary and trimmed hedges.	*Blenheim Palace*, Oxfordshire. Landscape park, water parterre, cascade. *Chatsworth*, Derbyshire. Water cascade, fountains, rose garden, woodland garden. *Hampton Court*, London. Knot garden, maze, parterres.
Dutch (1690-1700) The Dutch garden is smaller and more cluttered than the French garden. A more extensive use of water, hedges, topiary and the featuring of trees (primarily citrus) in tubs.	*Compton Wynyates*, Warwickshire. Topiary. *Hampton Court*, London. Knot garden, maze, parterres. *Levens Hall*, Cumbria. Topiary. *Powis Castle*, Powys. Terraced gardens, woodland garden, kitchen garden, pinetum.
Landscape (1730-1830) Unmistakably English, the Landscape garden is completely lacking of any surrounding or confining walls. There are no straight lines or hedges. Hills and lakes are frequently man-made, but are done in such a fashion that a natural landscape-painting effect is created.	*Blenheim Palace*, Oxfordshire. Landscape park, water parterres, cascade. *Chatsworth*, Derbyshire. Water cascade, fountains, rose garden, woodland garden. *Luton Hoo*, Bedfordshire. Landscape park, terraces, rock garden. *Polesden Lacey*, Surrey. Arboretum.

Landscape (continued)	*Rousham House*, Oxfordshire. Landscape park, statuary. *Sheffield Park*, East Sussex. Landscape park, arboretum, woodland garden. *Stourhead*, Wiltshire. Landscape park, arboretum. *Stowe*, Buckinghamshire. Landscape park. *Warwick Castle*, Warwickshire. Landscape park. *Woburn Abbey*, Bedfordshire. Landscape park, Chinese dairy and pool.
Victorian (1830-1870) Formal gardens generally based on 15th-century Italian ideas. Extensive use of terraces, statues, fountains and steps. Beds are designed with a geometric pattern in mind. Topiary is generally used.	*Athelhampton*, Dorset. Topiary, terraces. *Bodnant*, Gwynedd. Arboretum, woodland garden, water garden, terraces. *Chatsworth*, Derbyshire. Water cascade, fountains, rose garden, woodland garden. *Hever Castle*, Kent. Formal Italian garden, maze, water garden, statuary. *Luton Hoo*, Bedfordshire. Landscape park, terraces, rock garden. *Scotney Castle*, Kent. Arboretum, woodland garden.

The Classical Pantheon at Stourhead.

Reflecting Pool at Bodnant; at left is mature *Cedrus atlantica glauca*.

Modern (after 1870) Many types of modern gardens exist in Great Britain, but trees and shrubs predominate in all. The general pattern is for a garden to exist within a garden. Walled, enclosed gardens are common. Nearly all gardens of the modern period feature a woodland or naturally-landscaped area with a series of attractive views.

Bodnant, Gwynedd. Arboretum, water garden, woodland gardens, terraces.

Brode Hill, West Sussex. Woodland garden, pinetum.

Great Dixter, East Sussex. Herbaceous borders, topiary, sunken garden.

Hidcote Manor, Gloucestershire. Stilt hedge, walled garden, white garden.

Nymans, West Sussex. Herbaceous borders.

Savill Gardens, Berkshire. Informative border, arboretum, woodland garden.

Scotney Castle, Kent. Arboretum, woodland garden.

Sheffield Park, East Sussex. Landscape park, arboretum, woodland garden.

Sissinghurst, Kent. Walled gardens, white garden, herb garden.

Tresco Abbey, Isles of Scilly. Subtropical garden.

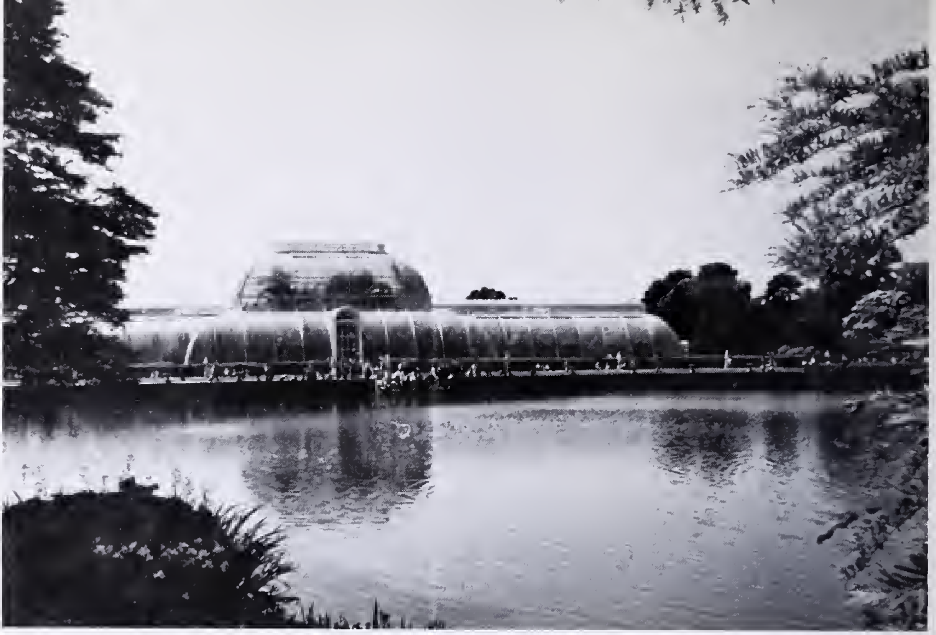
Wakehurst Place, West Sussex. Arboretum, woodland garden, rock garden.

Westonbirt Arboretum, Gloucestershire. Arboretum.

Wisley, Royal Horticultural Society, Surrey. Informative garden, pinetum, water garden, herbaceous borders.

Picturesque 14th-century castle and 17th-century house comprise the central theme of Scotney Castle.

Administration building and reflecting pool at the Royal Horticultural Society headquarters at Wisley.



Victorian conservatory at the Royal Botanic Gardens at Kew.

In addition to the Grand Style of gardening, a number of superb botanic gardens also exist in England. Basically designed as centers for the scientific study and collection of plants, these gardens can be of great interest to visitors. Some botanic gardens are not open to the public, but fortunately most are. Here the visitor can find outstanding collections of trees, shrubs, annuals and perennials, bulbs and tropicals. Principal among the botanic gardens of England are the Royal Botanic Garden at Kew, truly one of the world's greatest horticultural sights, and Royal Botanic Garden at Edinburgh.

In addition to the gardens listed, one should also consider a visit to Westonbirt Arboretum (Gloucestershire) and Tresco Abbey Gardens (Scilly Isles). These also might be considered botanic gardens, for there is only a thin dividing line between a grand and a botanic garden. ✤

ENGLISH BOTANIC GARDENS AND ARBORETA

Botanic Gardens and Arboreta	Special Features
Bedgebury National Pinetum, Kent	Conifers
Cambridge University Botanic Garden, Cambridge	Rock garden
Royal Botanic Garden at Edinburgh, Edinburgh, Scotland	Rock garden, arboretum; 15,000 varieties
Hillier Arboretum, Hampshire	Herbaceous borders, scree, heather garden; 10,000 varieties
Royal Botanic Gardens at Kew, London	Arboretum, rock garden, woodland garden, Queens garden, greenhouses; 25,000 varieties
University Botanic Garden at Oxford, Oxford	Variegated plants

Kitchawan Research Laboratory, BBG

A Chinese and a North American plant are crossed . . .

AND A NEW YELLOW MAGNOLIA IS BORN

A breakthrough in Brooklyn Botanic Garden's Plant Breeding Program has rewarded the Garden with a new, uniquely beautiful magnolia named, just last year, 'Elizabeth.' The Breeding Program was started by Eva Maria Sperber more than twenty years ago.

From its first flowering six years ago, magnolia specialists at the Kitchawan Research Station of the Botanic Garden were awed by the new offspring, which resulted from crossing the Chinese Yulan magnolia (*M. heptapeta,* formerly *denudata*) with the cucumber magnolia (*M. acuminata*) of eastern North America. The form of the tree is neat and loosely conical, but it is the shape and color of the flowers which sets this new plant introduction apart from any other magnolia presently grown. From finely tapering buds, petals unfurl to display flowers of the clearest primrose yellow. The parent tree has, in the past four flowering seasons, been a glorious spectacle from late April to mid-May, its boughs resplendent with hundreds of blossoms.

A special offer is being made to Members of the Botanic Garden—and only to

Yes, I want to participate in Brooklyn Botanic Garden's Plant Breeding Program. Enclosed is my check for $150.00, payable to Brooklyn Botanic Garden, for a plant of *Magnolia* 'Elizabeth'* to be dispatched in spring of 1980.

Please print

Name ______________________________

Address ______________________________

City ______________ State ____________ Zip Code ________

OR

I wish a plant to be sent as a gift to the following. My check for $150.00 is enclosed.

Name ______________________________

Address ______________________________

City ______________ State ____________ Zip Code ________

Donor name ______________________________

Donor Address ______________________________

City ______________ State ____________ Zip Code ________

*Acceptance of the above offer does not imply licensing. Propagation or dissemination of cuttings of *Magnolia* 'Elizabeth' is prohibited. All plants are in excellent condition at the time of dispatch and every care is taken to ensure safe travel by mail or parcel post. Although the Garden is not liable for the safe travel of the plants, we would appreciate your notifying us if the plant does not arrive in good condition. The Garden does not accept responsibility for the future health and well-being of the plant.

Mail this form and your check to:

Plant Breeding Program
Brooklyn Botanic Garden
1000 Washington Avenue, Brooklyn, New York 11225

Members—as it is unlikely that this magnolia will be available in the nursery trade for at least eighteen months. Patented in 1977, this plant may be propagated only by licensees of Brooklyn Botanic Garden.

BBG Members are being offered the opportunity of furthering the Plant Breeding Program by purchasing one of the small number of *Magnolia* 'Elizabeth' raised at the Garden. Due to patent rights, this offer applies only to plants to be grown *in the United States* at present.

An expertly wrapped and postpaid specimen, approximately 8-16″ in height, will be sent to these Members for a contribution of $150 or more to the Plant Breeding Program. Such contributions (less $25, this being the projected fair market value of the magnolia) are deductible for income tax purposes.

Besides contributing, Members who purchase the plants are also asked to take an active part in the program by telling us how their new magnolia fares. Questionnaires will be sent to them. A number of specimens are presently being tested in arboreta and research institutions throughout the United States and Canada, and these Members will be part of this team.

Orders will be filled on a first come, first served basis and dispatched this spring. Members may secure their magnolia by sending the enclosed order form and their contribution today. For Membership information please see the inside back cover of this issue. ❧

Oh, yellow board . . .

WHITEFLY CONTROL

Reprinted from
News & Views (American Horticultural Society),
March, 1979

Whiteflies have become serious pests of gardens, greenhouses and house plants in the North the past few years. They are tropical insects, cannot survive freezing temperatures outdoors and over-winter on plants in greenhouses and homes. They are taken inside on plants that were outdoors for the summer.

They are tiny sap-sucking insects, multiply rapidly and can kill small ornamentals such as fuchsias and vegetables such as tomatoes and squash in a short time. It takes a 10-power hand lens to really tell this is an animal and not just a speck of dust.

They look like tiny white moths as they sit on the underside of leaves. When the plant is jarred, they fly erratically about for a few seconds and then settle down again to feed.

Actually not a fly but related instead to aphids, mealy bugs and scale insects, the whitefly is one of the most difficult of agricultural pests to control, according to specialists, mainly because of its complex life cycle. The only effective insecticides against it, they say, are pyrethroids—high priced synthetic substitutes for a natural insecticide extracted from pyrethrum plants. There is no insecticide labeled for use against whitefly on food plants.

The Yellow Boards

Entomologists Ralph E. Webb and Floyd E. Smith, Department of Agriculture Science and Education Administration, Beltsville, Maryland, have been working on the problem for years and have discovered that homeowners and small-scale growers of greenhouse crops can use sticky yellow boards to control whiteflies.

In one experiment in a greenhouse, Webb and Smith placed one-foot-square yellow boards between tomato plants infested with whiteflies. Each day thereafter the boards trapped 25 percent of the adult whiteflies until the infestation was under control.

In a second experiment, on infested chrysanthemum plants, twelve boards evenly dispersed among the plants eliminated adult whiteflies in forty-eight hours.

In a third experiment, the researchers demonstrated the use of sticky yellow boards with another non-chemical control method: a parasitic wasp called *Encarsia formosa*, which is a natural enemy of the whitefly. The combined methods provided virtually complete control in the greenhouse.

While the parasites attacked and killed immature whiteflies, the boards trapped adults (*E. formosa* is sold as a control agent for whiteflies in Canada, England, Holland and Norway, but is not yet commercially available in the United States).

Insecticides

There are a number of pesticides labeled for control of whiteflies in the greenhouse. Some of them are not effective because the whitefly has developed resistance to them. Most of those that will give good control are highly toxic to humans. There are two, however, which are effective and are relatively nontoxic to humans.

One of these is Enstar 5E, a modified insect hormone and as such belongs to a new class of insecticides. It is labeled for whiteflies and aphids in the greenhouse, on ornamental plants and vegetable seed crops. Although it may not give a dramatic adult knockdown, it prevents eggs from hatching, kills young ones in the pupal stage and eventually eliminates the population.

Resmethrin, also called SBP 1382, is the other insecticide. It is a synthetic pyrethroid and available as an emulsified

Eva Melady

Barely visible to the naked eye, the wingless young as well as the flying adults attach themselves to the underleaf and suck the sap.

concentrate and an aerosol. This material gives a quick knockdown of adults but is not quite as effective on other stages.

Life Style

The whitefly lays 1/100-inch-long yellow eggs which are attached to the undersides of leaves in circular clusters. They hatch in four to twelve days into active pale-yellow, flat, six-legged young which resemble scale insect crawlers. They quickly find a place to settle down, insert their mouth parts and begin to suck sap.

After a few days they shed their skins, and in so doing lose all their appendages and now appear as minute, flat, oval, pale green, semitransparent scales with some white waxy threads radiating from their bodies. This is the stage usually responsible for spread of infestations.

The skin is shed again and after about a month the winged adult crawls out of a T-shaped slit in the back of the last skin. When the whitefly is indoors, generations eventually overlap and there are several overlapping generations a year.

Smith attributes the success of the yellow boards to the restless nature of whiteflies. As they fly from leaf to leaf, they are distracted by the color yellow and become stuck on the surface of the boards.

The yellow boards used in the USDA experiments were painted with Rust-Oleum 659 yellow, but other deep orange-yellow paints also would be effective. Of the many sticky substances tested, Webb found that Tack Trap, a commercial insect trapping compound, is best.

Smith found that heavy motor oil (SAE 90) is also an effective trapping material and that it is easier to wash off the boards than Tack Trap. The oil was used in most of their experiments, he says. ❦

Brooklyn Botanic Garden

The mature Coe pine bonsai.

How a rich and rewarding tradition started . . .

JAPANESE BEGINNINGS AT BROOKLYN BOTANIC GARDEN

Elizabeth Scholtz with George S. Avery

Reprinted from Bonsai Journal
(American Bonsai Society), Spring, 1979

During the second decade of the twentieth century, New York City's Borough of Brooklyn was embarking on a then-unique enterprise. The Botanic Garden, founded in 1910, was to have a Japanese Garden; and Takeo Shiota, an experienced garden landscaper from Japan, was to build it. It was later to become his masterpiece.

The construction years of 1914-1915 were busy ones, and Mr. Shiota's team of workers included two Japanese assistants and a horse. There was a spring in the area with sufficient flow to maintain a lake, which was built in the shape of the Chinese character for "heart." There was concrete work—which would become the famous echo caves—artfully concealed by stonework that made his composition into a series of cascades which today seem a natural part of this beautiful earth. The charming Shinto Shrine relates the whole to the nature-worship faith of the Japanese. The Viewing Pavilion, of modified Japanese Tea House design, gives visitors a key location for quiet contemplation of the miniaturized landscape—the lake, the island, the waterfalls, the drum bridge.

The first step in making Japanese culture—and horticulture—available for the education and enjoyment of Botanic Garden visitors was made possible by the late Mr. Alfred Tredway White, Brooklyn philanthropist and, at the time, Chairman of the Garden's Board of Governors. His gift thus became the first of the many gardens within the greater Garden. It heralded other phases of Japanese culture and horticulture to come.

In 1925 a Connecticut plantsman, Ernest F. Coe, sensed the potential of what was happening at Brooklyn Botanic Garden (hereafter referred to as "BBG") and gave a collection of thirty-two dwarfed potted trees that he had imported from Japan some years earlier. Although they were the nucleus of the present Bonsai Collection, they apparently were not received with very great enthusiasm. There is no record of their ever being exhibited or given more than very routine care until after the close of World War II when Dr. George S. Avery, the Garden's second Director, discovered them.

It was at about this time that occasional inquiries began to trickle in from Japan, and the Garden's Annual Report for 1947/1948 records the addition of Mr. Frank Okamura to the gardening staff, the first such appointment of Japanese talent. The need for his gardening skills was apparent. The Japanese Garden (cautiously called the "Oriental Garden" during the war) had been closed for some years. Prewar-born animosity had led to the Shinto Shrine and the Viewing Pavilion being burned to the ground, the former in 1937.

In 1957 a thoughtful gift from Mrs. Arthur Larsen, in memory of her late father, made possible the reconstruction of the shrine, plans having been prepared by Mr. K. Ishida of Tokyo, who was known to our principal Japanese correspondent, Mr. Kan Yashiroda of Shodo Island. The shrine is a faithful replica of the original and was dedicated on May 1, 1960, by The Honorable Ryotaro Azuma, Governor of the Metropolis of Tokyo, as the opening event of BBG's 50th Anniversary celebration. The Viewing Pavilion, burned in February, 1948, was rebuilt with funds supplied by the City of New York.

Bonsai Interest

With each postwar year there were increasing numbers of letters from U. S. Army of Occupation personnel in Japan, inquiring how they could arrange to bring bonsai into the United States. Plant quarantine rules made it practically impossible, though a few managed to smuggle small bonsai in their rucksacks. Once back, there were many perturbed inquiries: "How do we take care of them?" When such correspondence grew to several letters a week, a still-new BBG Director realized that the bonsai spark was growing into a full-fledged conflagration.

The Coe gift of thirty-two bonsai had dwindled to eleven rather miserable, uncared for specimens, but at least they had been re-discovered, and the growing interest seemed to indicate that a handbook issue of the Botanic Garden publication, *Plants & Gardens,* should be devoted to bonsai. A circumspect letter went out to six well-known and highly respected horticulturists at different botanic gardens, mentioning the growing interest as measured by BBG plant information correspondence. Did they think such a handbook was warranted? In their judgement might there be a demand for it? To a man the reply was NO. This seemed to be one of those times when advice was sought, then discounted in its entirety.

Mr. Kanichiro Yashiroda was invited to be the Guest Editor of BBG's first bonsai handbook, which was *Bonsai–Dwarfed Potted Trees.* Mr. Yashiroda had spent a year at England's famous Kew Gardens many years before, and his English (unused during the war years), though rusty, was understandable. Through his "Acclimatization Garden" on Shodo Island, he had communicated with professional and amateur plantsmen the world over—people he knew or knew about through his year at Kew. He invited Japanese bonsaimen, amateur and professional, to write for the handbook-to-be and laboriously translated their articles into English. The typed manuscript and

Philip B. Mullan

The stone water basin in the Roji Garden at the Brooklyn Botanic Garden.

photographs arrived at BBG late in 1952 and, after a bit of manuscript midwifery by Frances Miner and George Avery, came out as the 1953 autumn issue of *Plants & Gardens*. It quickly became a classic, and for a number of years it was the only how-to book on bonsai in the English language, other than the one in the "Japan Travel" series which was not quite adequate in how-to terms and not in tune with the needs of amateur American hobbyists.

Courses and Film

Once the bonsai handbook was born, the next step was for the BBG Instruction Department to set up a learn-by-doing bonsai course. The 1953/1954 Annual Report of the Garden relates that Messrs. Avery and Okamura gave a three-session beginner course, which was attended by nearly one hundred people from all walks of life. In the spring of 1955 Mr. Yashiroda was invited to come, on a short-term fellowship, to teach bonsai courses at BBG. More than one hundred fifty students registered for his classes and took home the promising young bonsai they learned to train and grow. Mr. Yuji Yoshimura later held a similar fellowship and stayed on in this country to found what has become a well-known bonsai business. In 1963, Mr. Yashiroda came back on a teaching fellowship. BBG classes spawned many bonsai enthusiasts and semi-professionals whose names are now known in bonsai circles throughout the country. Indeed, more than six thousand people have taken bonsai courses at the Botanic Garden in the past twenty five years, and they have come from every state east of the Mississippi River. Bonsai clubs, regional and local, are now widespread, and there are now well over one hundred sixty state and/or national societies.

Picking up the thread of ever-widening enthusiasm as related to BBG, interest grew among the Trustees. Mr. and Mrs. Edward Holsten, on a world cruise in 1958, visited some of the finest bonsai nurseries in Japan, and brought back a number of superior bonsai from Japan. A gift to BBG later that year made it possible for the Averys to go to Japan in April and May of 1960, with instructions (and gift funds in hand) to purchase "distinguished" older bonsai for the Garden's expanding collection. Mr. and Mrs. Howard Phipps, Sr., traveling in Japan in the 1950's, brought back a number of bonsai to start a collection which bears their name. Mrs. Emmet J. McCormack acquired specimens from a California bonsaiman and later made a gift for the acquisition of the famous bonsai Fudo (which tragically failed to survive after arriving in this country).

Mr. Okamura made additions to the several named collections mentioned, both with trees he collected in the wild and with trees he has trained from seedlings and cuttings. His duties once included care of the Japanese Hill-and-Pond Garden but are now confined entirely to the care and training of the many hundreds of bonsai in the collections and to the courses he gives in collaboration with other members of the BBG staff.

A large "indoor bonsai" exhibit, selected from the Garden's collection of about two hundred mature specimens, was staged in the conservatories as a special bicentennial celebration in February, 1976. These tender plants, trained by Mr. Okamura, were presented as house plant candidates for bonsai fanciers. At the time, a commemorative supplement was published which included a descriptive list of plants suitable for indoor bonsai. There followed the publication of a handbook titled *Bonsai for Indoors.* Prior to this, in 1966, the Garden published still another handbook, *Bonsai: Special Techniques.*

In 1971 Ian Clark produced BBG's award-winning twenty-one minute film called *Bonsai—The Art of Training Dwarfed Potted Trees.* It is the fourth teaching film in the BBG film series and has been widely purchased by bonsai enthusiasts and clubs, as well as circulated (through rentals) directly from the Garden's Film Library and through the American Bonsai Society which has purchased copies. The BBG Auxiliary has generously financed the making of all the Garden films. Another bonsai film, produced in Japan with narration in Japanese, is a current gift to the Garden from the Nippon Bonsai Association. Mr. Masahiko Miyano has translated the voice track into English, and copies of the translation are available from BBG.

Present and Future

Other Japanese cultural exhibits at BBG include the magnificent replica of the Stone Garden of the Ryoanji Temple in Kyoto. Staff members Elizabeth Scholtz and Anne Birdsey made a study of the Kyoto garden, and construction was begun in 1964 under the guidance of Paul Takuma Tono, an architect and landscape architect from Tokyo. This replication at BBG would have been totally impossible without the most generous financial support of BBG's longtime member, friend, and supporter, Mrs. Kenneth W. Hume of Carmel, New York, and Mr. Alden Dow of Midland, Michigan. A Roji (Dewy Path) Garden was planned by Mrs. Polly Fairman of Princeton, New Jersey, and opened to the public in 1972.

Looking to the future, the Garden hopes eventually to construct a greenhouse complex in which more bonsai can be exhibited. Meanwhile, there is need to refine the collection by concentrating on the finest specimens, and "deaccessing" anything deemed second-rate. A grant from the National Endowment for the Arts has made possible the cataloging of all the bonsai in the several collections.

The BBG bonsai collections which now total over one thousand hardy specimens and two hundred indoor bonsai should not be missed. How great the impact of the Garden's displays on nearly 500,000 visitors a year is hard to gauge. ❧

Some of the old ways continue . . .

A SUMMER OF CHINESE BONSAI

Don Lem

Adapted from Bonsai Journal
(American Bonsai Society), Fall, 1979

During a visit to the People's Republic of China I took every opportunity to look for bonsai wherever they might be found. As a result, I saw hundreds of bonsai in many different settings, ranging from a few used as decorations in a restaurant to extensive displays at public exhibits. I was impressed by the feeling that these bonsai were the result of many years of bonsai experience. I could feel their age and imagine the adverse conditions of nature that could produce such trees.

The large size of both the trees and the containers was also noticeable. There were pots in great variety, glazed and unglazed, new and old. I was informed that the sale of antique pots for export was now prohibited without government permission. Many containers had decorations including inscriptions on the sides. Occasionally, a wall-hanging plant was used for a cascade bonsai. The cascade is hung on the wall for display instead of being placed on a high stand. I received such an old pot as a gift; however, it was necessary for me to take it to the government office to have it stamped for export.

Rockeries were very popular, especially in south China. These are plantings of rocks and dwarfed trees in large containers to suggest distant mountains or islands. Many of the long, low containers used for rockeries are carved from a single piece of marble or soapstone.

As I traveled through China, I was impressed by the many large old trees that I saw. Some that were very tall appeared to be old Japanese maples (*Acer palmatum*). One such maple, a hundred feet high, was said to be more than a thousand years old. The leaves on the ancient maple trees were exceedingly small. It was impossible to determine whether the small leaves were caused by old age, or whether the maples were a special small-leafed species.

In Peking and northern China, I saw bonsai displayed as decoration in restaurants, tea-houses and park settings. There were bonsai in the tea-room of the famous Summer Palace. Several were also placed outside to be enjoyed from the windows of the tea-house. This was not a regular exhibit, nor were the bonsai for sale.

More northern species—pines, maples and junipers—were used in Peking than in the South. A few northern styles were not seen in the South, such as a closely clipped "poodle-like" style. I rarely saw a rockery in the cooler northern climate.

On the side streets of many cities in China I came across stores where Chinese buyers could choose bonsai material, containers, trees and rocks. Prices seemed low in U.S. dollars. But a bonsai pot priced at $2.00 (U.S.) cost the equivalent of a month's rent for an apartment in China. By Chinese standards, the pot was a luxury.

The center of bonsai exhibits and production is in south China. At East Park, in the city of Canton, bonsai produced at a nearby government commune were on display and offered for sale. This was the only official bonsai sales outlet in the area. At East Park, I met a man who was a boatman by trade. He took me in his boat to the commune outside Canton where some of the bonsai are grown. Here, I was privileged to meet the bonsai master, Look Hock Ming, who is the third generation of his family to grow bonsai.

I also saw a large *Sageretia thea* (*theezans*) belonging to Mr. Look. It was in a three-foot pot and trained by him for nine years, and is looked upon as a future masterpiece. A new government ruling since the death of Mao permits commune members to have personal bonsai of their own.

At the commune, bonsai are trained in the ground and in pots. I was particularly impressed with a technique in which strips of plastic are wrapped around the trunks of recently transplanted bonsai to prevent evaporation. The plastic is removed after new growth starts. I also noticed unusually large-size particles of clay in the potting mix.

Bonsai Shows

At the People's Park in Canton I happened to see an outdoor bonsai show and sales area that appeared to be for the local residents. The entrance sign read, "p'en-ching" which, literally translated, means "scenery in pot." Here, many of the bonsai contained figurines which I did not usually see at other exhibits. The name of the bonsai and/or a poetic description of the tree was frequently inscribed on the pot.

The Yuk Sui Yuen bonsai exhibit (also in Canton) which I attended in May, 1978, was the first Chinese public bonsai exhibit in ten years. I was told that previously the "Gang of Four" prohibited bonsai, and that now an annual show is planned. The exhibit was in a public park with approximately two hundred fifty bonsai from private collections. The entrance fee was 2½ cents.

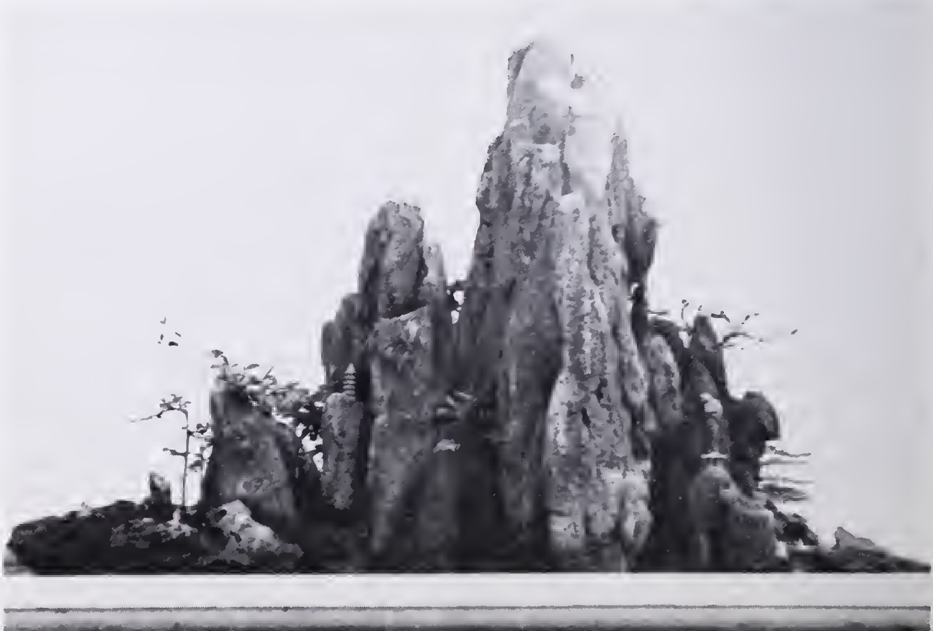
The show was in two sections. The first was outside and the second, with better bonsai, was in a building. Many antique pots were displayed, including old incense burners now converted to bonsasi use.

Rockeries are very popular in the South. Many that were on display used material from areas of limestone formations, called karst. A bonsai replicating of these oddly shaped formations in the Kwangsi area of southeastern China is shown below. The climate of south China between Canton and Shanghai, including Soochow and Hangchow, is particularly suitable for large outdoor rockeries.

A large number of bonsai exhibited at Yuk Sui Yuen were grown by the Lingnam method whereby the trees are shaped entirely by pruning. They were primarily deciduous trees such as Chinese elm (*Ulmus parvifolia*), *Sageretia thea,* Chinese hackberry (*Celtis sinensis*) and Fukien-tea, (*Ehretia microphylla*). I was interested to see a bonsai of *Glyptostrobus lineatus* (*pensilis*) that closely resembles our American bald-cypress (*Taxodium distichum*). The water-pine, as this *Glyptostrobus* is called, is a deciduous tree of south China that grows by rivers and swamps. Its roots are normally under water all year round.

I was privileged to meet the sponsor of the Yuk Sui Yuen show, Wu Lake Mien (not to be confused with Wu Yee-Sun, the noted bonsai enthusiast of Hong Kong). Wu Lake Mien is the developer of the rare tree peony bonsai which he exhibited

Rockery of limestone suggests the formations seen in Kwangsi Province.



Author

at the Chinese Peony Flower Exhibit in Macao. Mr. Wu took me to his home where I saw his outstanding bonsai collection which he maintains on an eight-foot-wide roof top.

During my visit I was in a culture that is very different from America, yet beneath the differences one could see how much people are alike. In China, as in America, there were people with friends and family, people enjoying gatherings, and people with their hobbies, including bonsai.

Gottscho-Schleisner

GARLIC CHIVES

Herbs don't always look their best as summer progresses, but neither do we. Do you want one that is beautiful in August? Then send along a stamped, self-addressed envelope to the Editor (BBG, 1000 Washington Ave., Brooklyn, NY 11225), requesting seeds of garlic chives (*Allium tuberosum*). No need to fear if you don't like garlic, as is rumored of some people who live west of New York's East River. The taste is really oniony, and the ideal use is to snip a few leaves for salads or sour cream and chives for baked potato.

But what about the plant? Garlic chives are close to two feet in height when flowering in late summer. The blossoms are small white stars in clusters that are conspicuous some distance away. The plant is perennial and can be grown just about anywhere except on the desert or Mt. Everest. In the garden it is a good neutralizer—garlic chives will complement anything but a giant-sequoia. We like the plant. In fact, we've never met an allium we didn't like at first bite.

A successful instance of biological control . . .

THE BEETLE AND THE BINDWEEDS

Yong H. Kim

Reprinted from NAHO
(New York State Museum), Summer, 1979

Just about every farmer has come up against various types of bindweeds. The clinging, twisting vines of the perennial hedge and field bindweeds (*Calystegia sepium, Convolvulus arvensis*) are especially difficult to control as they creep throughout North America and Europe, destroying crops wherever they spread. But new hope looms large for farmers. The stubborn bindweed may have met its match. The Argus tortoise beetle, often called a gold bug, has a voracious appetite for two kinds of plants: field and hedge bindweeds. The insect hardly touches other plants, including economically important agricultural crops, excepting the sweet potato.

The value of the beetle's ability to devour the bindweeds on a large scale is being studied by Professor G. Wilbur Selleck of the New York State College of Agriculture and Life Sciences at Cornell. A specialist in plant ecology and weed control, he is stationed at Riverhead as superintendent of the college's Long Island Horticultural Research Laboratory. "There is a real potential for using this beetle as a means of controlling the bindweeds," Selleck said in a recent interview. "In fact, the beetles do a better job than a chemical weed killer recently cleared for use in vineyards and orchards."

Selleck first spotted the beetles feasting on their favorite food in 1977 in an abandoned field near Riverhead where he was experimenting with herbicides to control hedge bindweed. Since then, he has followed the activities of the insect.

"The beetles completely decimated the hedgeweed in a small patch, and regrowth of this weed failed to develop throughout the remainder of the season," Selleck stated.

The Cornell scientist returned to the field in the spring of 1978 to continue observations. Unlike the previous year, the population of the gold bug exploded, and the beetles were eating the weed everywhere in the area. They devastated the bindweed throughout the six-acre field.

"The weed was wiped out one hundred percent," Selleck points out. "By mid-July, not a single bindweed plant could be found in the entire area of weed infestation." What has intrigued the scientist most was that there was no evidence of this insect feeding on any of about one hundred other plant species in the area.

When the weed supply ran out, adult beetles died by the bushel. By the end of July, live specimens of the beetles or bindweed were rare. Surviving beetles made a mass exodus into nearby patches of sweet potatoes, which they promptly destroyed. A member of the bindweed family, sweet potatoes are known to be a source of food for the beetles.

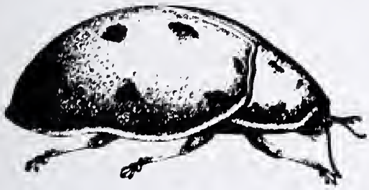
Other beetles marched into a corn field and cleaned up the bindweed across twenty-four rows while leaving the corn plants intact. Interestingly, the beetles migrated on foot, although they have wings. After the bindweed supply was gone, most of the beetles died.

"The great number of dead beetles found confirmed earlier observations that this insect cannot survive on other vegetation," Selleck commented.

While keeping track of the beetle activities in these areas, Selleck "introduced" the insects to half a dozen other locations where corn, field rye, zucchini, grapes, ornamental shrubs (yew and euonymus) and pine trees were growing. The gold bugs, as expected, demolished both hedge and field bindweeds in these locations, but there was no sign of feeding on any of the food or ornamental plants.

Meanwhile, Selleck has successfully reared the beetles in his laboratory. Both larvae and adult beetles thrived on bindweed leaves, but when fed only "delicacies" such as Irish potato leaves and parasitic field dodder, they refused to eat them and therefore died.

On the basis of his observations and findings thus far, Selleck is convinced that tortoise beetles can be reared in the laboratory by feeding them bindweed and possibly sweet potato to serve as a supply for establishing insect populations at bindweed-infested locations. The use of insecticides on the crops during the active period of larvae and adult beetles negates the use of beetles as a biological weapon in the battle against bindweeds. But if no insecticides are used, Selleck believes that both hedge and field bindweeds can be eradicated with three consecutive years of intensive depredation by the beetles.



Drawings by Claire Winhold

The Beetle Native to North America, the Argus Tortoise beetle (*Chelymorpha cassidea*) is one of several species called the gold bug. Because the edges of the insects' wing sheaths extend like the shell of a tortoise, it is called a tortoise beetle. These insects eat only the plants of the morning glory family, mainly the bindweeds and the sweet potato.

Producing only one generation each year, they spend the winter as adults in dry, sheltered places. This insect is the prey of at least fourteen species of birds, particularly the starling and the kingbird.

The Bindweeds Common in New York State, the bindweeds (*Convolvulus*), especially field bindweed, are one of the most widespread perennial weeds in much of North America and Northern Europe. It is difficult to keep this weed from growing among cereals, fruits, potatoes, and ornamental plants. Both hedge and field bindweed grow from 3 to 20 feet long, twisting about and clinging to other plants for support. For example, the leaves of a single bindweed plant may almost cover the foliage of a 20-foot-tall pine tree.

WHY DO HOUSE PLANTS GO TO POT?

George ("Doc") and Katy Abraham

Reprinted from FLOWER AND GARDEN,
November-December, 1979

Of the 100,000 inquiries we receive annually from our newspaper columns and our radio and TV shows, about sixty percent deal with indoor plants. The plant boom in America has put from 800 to 1,000 new kinds of pot plants on the market in the last ten years.

Some of these are a lot touchier than the old standbys that have been around for years. Many other things have changed besides the selection of plants. These include soil mixes we've never had before and markedly different types of containers. In short, there are a lot of reasons why house plants don't always fare well indoors.

Based on our twenty-five years as commercial growers, we'd like to present some of the most common reasons why house plants limp along or die off.

1. *Overfeeding:* Fertilizer is no cure-all. Feeding a sick plant a plant food is like forcing a thick steak down a sick person. Most house plants are not heavy "eaters." Under normal conditions indoors, a light feeding once every two or three months is plenty. Too much fertilizer can cause a buildup of soluble salts which will burn the feeder roots, especially if the plant goes dry. This prevents the plant from taking up water, and the result is tip burn or leaf scorch. Excess fertilizer can injure roots and can cause plants to slow down in growth, instead of perking up. Newly purchased plants seldom need a feeding for two or three months, or even longer. Due to the unprecedented demand for plants during the past few years, some growers have overfed them to push them along faster, so they will be a salable size within a short time, hence they are already overfed. Some state colleges recommend flushing the soil ball of newly purchased plants to remove the excess soluble salts.

One reason why some people overfeed is that they think growth of plant tissue comes from nutrients in the soil. "The more nutrients the more growth" idea is a myth. Less than two percent of the plant's tissues are composed of minerals absorbed through the roots in the soil. The remaining ninety-eight percent of the tissues comes from air (mainly carbon dioxide absorbed through the leaves) and water (absorbed through the roots).

2. *Bad Watering Practices:* Watering is an art. Commercial growers tell you that the person who waters the greenhouse plants controls the purse strings.

As with fertilizer burn, dry soils produce the same effect on all house plants (except cacti)—leaf scorching, plus browning around the edges. This type of injury is similar to outdoor winter drying of evergreens (called desiccation). The sun and dry air cause water to be lost faster than it can be taken up by the roots. Movement of the sun and earth can play tricks on your plants. For example, in the autumn you may make room for your shade loving plants in a northwest exposure and conclude they get little if any direct sun, but as the season goes from winter into spring, that same window gradually becomes as hot as an unvented and unshaded greenhouse for several hours each day. This can be a particular problem for persons who work during the day and are home only on weekends when they're often too busy to note the change.

Most house plants such as hydrangeas, azaleas, calceolarias and others show a drooping of foliage as soon as moisture gets too low. However, drooping can happen if the soil is too wet or too compact to allow water and air to circulate freely. More house plants are killed or ruined from overwatering than from anything else. They all need good drainage—both air and water drainage—around the roots.

3. *Roots Need Air:* Air is just as vital in the soil as it is in the atmosphere. One of the most important functions of roots is to take in oxygen for growth. (Many think it comes only through the leaves, but not so.) If a soil is too fine, too clayey, or too humusy, it locks out oxygen around the roots when it becomes wet. Leaves start to "cup" or droop, turn yellow, then black, then shed. Oxygen decreases as the soil is watered and approaches zero when soil is "soaked." A plant standing in completely soaked soil can wilt and die from a lack of water because plant roots can absorb moisture only if air is present in the soil. Water is a food, but a plant can take up only so much.

Why is watering such a confusing chore? The answer is simple: Plants differ in the amount they need. *Dieffenbachia* (dumb cane), schefflera *(Brassaia)*, pygmy date palm *(Phoenix roebelenii)*, *Peperomia, Araucaria* (Norfolk Island pine), *Ficus elastica* 'Decora' (decorative Indian rubber tree), *Monstera deliciosa (Philodendron pertusum), Nephrolepis exaltata* (swordfern), are just a few plants which will drop foliage if overwatered.

4. *Wrong Container:* The type of container makes a big difference when it comes to watering. Plants growing in a glazed or metal or plastic pot are doomed if you don't watch the watering. These pots do not breathe and do not dry out quickly. Soil in these pots should be only slightly moist, or slightly on the dry side between waterings. Clay pots are different. Over fifty percent of the water you add to a clay pot is lost from the sides due to evaporation, so there's less chance for overwatering but more chance for plants to dry out quicker in clay pots. Don't water plants in plastic or ceramic pots as often as you do those in a clay pot.

You can grow good plants in plastic pots, but these pots can be deceptive. Here's why: The top of the soil might feel dry to your finger tips, but the lower half might still be wet, prompting the grower to pour more water on the dry top. Amateur growers are finding the new water meters a great help in determining if water is needed. These are not gadgets. Some commercial growers use them for servicing plants in malls and office plantings. They come with probes of various lengths and are valuable for checking the need for water in large pots. The only time you might not get an accurate reading is when the soil has excess soluble salts. Some gardeners determine if a plant is thirsty by inserting a lollipop stick into the soil. Pull it out. If soil particles cling to it, no water is needed. If it comes out "clean," add water.

5. *Low Temperature Injury:* Don't let double thickness glass windows fool you into thinking that they are protection from cold weather. In midwinter and early spring many people wonder what causes sudden wilting and browning of tender plants such as African-violets, maranta, fittonia, lipstick plant (*Aeschynanthus*), episcia and dozens of other tropical items. Such injury was especially prevalent during the winter of 1977. The cause is chilling. Weather forecasters could do a lot to alert plant growers by giving the "wind chill index factor." This is the term for a combination of wind velocity and temperature reading. The wind chill index tells you it's colder than the thermometer says. For example, if your thermometer says 10°F with a 10 mile per hour wind outside, the wind chill makes it the equivalent of 9 degrees below zero! This wind chill factor should scare you into taking steps to protect plants, as well as save fuel. You can save as much as eighteen to twenty-five percent on your fuel bill, simply by drawing your draperies or curtains at night. If you don't have curtains, plastic sheets fastened to a frame and draped over the window will cut down on the cold. Your window is like a huge chunk of ice set in a wall. Plants give off more heat to the window than they can take in. Result: "freezer burn,"—limp, floppy leaves, followed by browning.

6. *"Bud Drop Syndrome":* People who grow African-violets, gloxinias, azaleas, poinsettias, and the like have experienced bud and leaf drop. There are many reasons for it: hot dry air, excess feeding, gas fumes, overwatering, changes in temperature, drafts and closeness to heat elements—all will cause quick defoliation as well as bud drop.

Often when you bring plants indoors in fall, roots are disturbed, especially when they have been allowed to grow through holes in bottom of pots. Breaking off roots is a shock, causing foliage to yellow and drop.

7. *Insects:* It's a good idea to inspect your plants at least once a week to keep insects from getting a head start. A magnifying glass is a handy tool and should be used if leaves look mottled or flecked. Spider mites are so tiny they are hard to see. You can also hold a piece of white paper under leaves and tap them sharply. If tiny specks fall onto the paper and start crawling, you have mites. Puckered leaves and sticky material around plants may indicate aphids, mealybugs or scale. Yellowing leaves are also a symptom of insect injury. Thrips can cause bud drop. Whitefly sucks juices from leaves, causing yellowing and attracting a sooty fungus that forms on leaves. Sudden wilting of plants may be caused by larvae of various insects attacking the roots. Holes in leaves usually indicate that a snail has sneaked inside in the hole of a pot or in the form of an egg.

8. *Poor Potting Soils:* One reason why plants do poorly is that they have the wrong type of potting soil. As mentioned, poor air and water drainage are main causes of plant woes. Many of our commercial potting soils are "fluffed up" until they are as fine as flour. Their fibrous structure has been broken down and that means bad air and water drainage. That's why we recommend adding washed sand or perlite to the mixture you buy, using at least one-third by volume.

Penn State Soil Testing Laboratory ran a test on twenty commercial potting mixes and found that one out of every five mixes could injure or kill house plants. Four of the twenty samples had excess soluble salts, enough to cook roots.

People who make up some commercial potting mixes add fertilizer to the batch. Also, when the mixes are stored in bags, they sometimes heat up due to activity of microorganisms, which release extra nitrogen as protein is broken down.

Of the four out of the twenty samples having excess salts, the readings were 320, 380, and 450, and 600. Any reading over 180 will probably cause plant injury. What to do? Add perlite (medium grade) to your potting mix to absorb the soluble salts and to help increase air and water circulation around the roots. As a final note, don't think because a soil mix is black that it's extra good. Color has little to do with quality of a potting soil. Drainage is the important factor.

There are many reasons why plants slow down, fail to grow, or konk out altogether. Most house plants send out distress signals. Learn to diagnose them. Inspect regularly; if the plant looks sickly for no obvious reason, inspect the roots and soil ball. If you water and feed sensibly and maintain the proper light and temperature, there's no reason why your plants won't grow and flourish for you. ⁂

CLEAR POTS AND HOUSE PLANT GROWTH

Reprinted from GARDEN GUIDES, September 24, 1979
(Cooperative Extension, New York State)

You may find some house plants in need of repotting. Before carrying out this job, read on about some recent findings that come from the University of California. They have found that the color of a pot can affect the development of a plant's root system. This sensitivity of a root system to light was observed on poinsettia, chrysanthemum, schefflera and certain species of palm and ficus. It is most obvious with those plastic pots where the color allows a significant amount of light to come through the sides. Any pots that are translucent (white as well as any other colors that will allow enough light to pass through to let objects be seen) are suspect. Although the total root system of plants growing in this container is significantly different, the most obvious characteristic is found on those roots reaching the inside wall. They immediately grow straight down to the darkness of the bottom of the pot. There is also an absence of feeder roots on the outside of the root ball when compared to plants grown in pots that are opaque. ⁂

A NEW PLANTER FOR BUMPER CROPS ON A CITY TERRACE

Joanna May Thach

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High above the city, snap peas, curly cress and plump red tomatoes thrive—without soil—on V. Elaine Smay's east terrace. Her lush hydroponic garden glows like an emerald against the mid-Manhattan skyline.

Miss Smay, who is an associate editor of Popular Science magazine, has been a hydroponic farmer for the past three years. By this technique, she has harvested bumper crops of zucchini, cucumbers, beans and peppers in a limited 5-by-10 foot space.

How It Works

Hydroponics, an agricultural method that uses no soil, has been known since ancient times. Plants are set in an inert growing medium (perlite and gravel), while dilute solutions of nutrients are periodically delivered to the roots. Since the plants receive a chemically balanced diet, they do not have to develop extensive root systems in search of food. Seed can be sown about half the distance apart that is normally allowed for soil gardens.

"Since the inert material used in the growing bed is virtually sterile, my plants are not troubled by soil-borne pests. Weeding and fertilizing chores are eliminated. Where weight of the garden is a problem, a hydroponic system may be the answer because perlite and gravel are lighter than soil," Miss Smay pointed out.

Elaine Smay grew up on a farm near Maryville, Missouri, where she learned how "well-grown vegetables should look and taste." As a student in Michigan, she and a friend rented a plot and raised vegetables. Today her sunny apartment is a testimony to her love of plants—baskets of airy ferns, poinsettias and ivies soften the crisp blues, greens and creams of her decor.

The sleek lines of the hydroponic growing units on her terrace and in her bedroom blend unobtrusively with the furnishings. Available in a variety of sizes, the hydroponic module is an ingenious two-tier affair. An upper growing bed, where the plants are rooted, is a six-inch PVC pipe. It is connected to a four-inch pipe that holds the nutrient solution. An aquarium pump, regulated by an inexpensive timer, sends the solution directly to the plants' roots several times a day. The nutrient solution then drains back to the reservoir for reuse. (Miss Smay's timer is set at 7 A.M., 11 A.M., 3 P.M., and 7 P.M.).

Her terrace unit, which is 10 feet long and weighs about 130 pounds, costs $310 shipped freight collect. A five-foot module, which she used indoors (under four wide-spectrum grow-lights that are on 16 hours a day), sells for $195. These prices include the pump, timer, perlite and gravel growing medium, and a four- to six-month supply of nutrient concentrate. Her modular systems were designed by Homeland Industries, Inc., 1545 Ocean Avenue, Bohemia, N.Y. 11716. The lighting assembly that fits her indoor unit sells for $120 and includes four bulbs and a timer. Vertical-type hydroponic arrangements are available from Lloyd Laboratory, 653 Walnut Boulevard, Brentwood, Calif. 94513.

Setting up the hydroponic system is relatively simple and does not require mechanical expertise, according to Miss Smay. First, make sure that the unit is set on a level surface. Then place the plastic filters over the tube openings that lead to the nutrient reservoir. Cover the filters with gravel. (Filters keep the growing medium from clogging the tubes.) Second, fill the growing bed with perlite to within an inch of the top. Miss Smay uses a top covering of gravel to keep the perlite from blowing. Third, moisten the perlite thoroughly with plain water or nutrient solution.

Sowing Seed

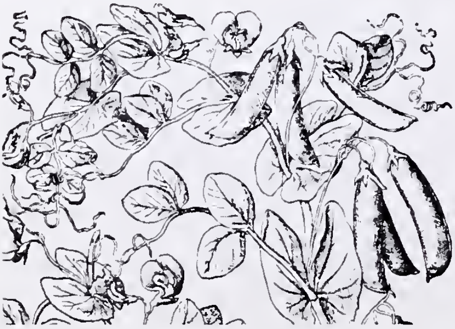
Miss Smay uses water and the nutrient reservoir when she plants seed. Seed is sown directly in the gravel. By experience she has learned to gradually increase the strength of the nutrient solution as the plants mature. She cautions the novice against souping up the solution for seedlings. "I tried a double-strength feeding on six-inch tomato plants and got yellow leaves and brown spots," she added ruefully.

It is also possible to fill the growing bed with seedlings started in soil. Before transplanting, wash the roots gently in tepid water to remove the soil. Make a hole in the dampened perlite, set the plant in "comfortably," and tamp the perlite firmly around the steam. Cover with an inch-deep layer of washed gravel.

Although hydroponic gardening is pretty "goof proof," there are some chores that can't be ignored. Surface evaporation and transpiration from the plants make it necessary to replenish the water in the growing bed. How frequently you have to add makeup water depends on the temperature, humidity, size of plants and speed of growth.

"I might plan a week's vacation in early spring, when the weather is cool and the plants are young. At this time I may have to add water every three to four days," she explained. "But in summer, when the garden is mature and the crop nearly ready for harvesting, it may be necessary to add water everyday."

On a recent visit the editor-gardener was busily changing the nutrient solution, something she does every two weeks. A sight gauge on the side of the module shows the nutrient level. She slipped the top of the sight gauge out of the growing tube and let the solution run out. After draining the unit completely, she replaced the sight gauge and poured the new solution over the top of the growing bed.



Once a month, when changing the nutrients, this city gardener flushes the bed with plain water to wash out any fertilizer salts that tend to accumulate.

The whole unit should be dismantled and cleaned annually, as follows: Pull out all the roots, discard the old growing medium and sterilize the tubes with a solution of one tablespoon of chlorine bleach per gallon of water. Rinse thoroughly and the module is ready for refilling and planting.

Miss Smay's 1979 hydroponic garden features Burpeeana Early tomatoes and Sugar Snap peas, intercropped with Curlycress garden cress. Her snap peas were sown outdoors on April 21 and were up by May 1. Her terrace is now bound in plastic sheeting to cut down on wind damage.

The first year she installed her system, the hobbyist admitted she was overambitious. "I had four varieties of peppers, celery, zucchini, beans and tomatoes. The tomatoes were grown indoors in a south window and then finished under grow-lights. I had to shake the blooming vines vigorously to pollinate the tomatoes and then spray them with a bloom-setting hormone," she recalled.

Her plans for 1980? She intends to repeat her present crop and perhaps experiment with herbs.

Miss Smay urges the novice to learn as much as possible before starting a soilless garden. Two books that she recommends highly are James Sholto Douglas' *Beginner's Guide to Hydroponics* (Drake Publications) and Richard E. Nicholls' *Beginning Hydroponics* (Running Press, Philadelphia). Both books include source lists for supplies. Information also may be obtained from a nonprofit membership organization, the Hydroponics Society of America, P.O. Box 516, Brentwood, Calif. 94513. ☘

YOU'RE NEVER TOO OLD TO DIG IT

Jean Perry

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Gardening as a means of mild exercise for the elderly? Most people never thought of it, but as every gardener of any age knows, the bending, stretching, walking and squatting required in gardening are basic exercise postures. And these postures, done regularly at a moderate or even slow pace can constitute a form of mild fitness for people over 70.

Dr. Harold Gross, a New York State cardiologist, is in favor of the elderly gardening. "I think gardening is an excellent form of mild exercise for the elderly provided they don't take on more than they can comfortably handle," said Gross. "And, of course, they have to follow their doctor's specific instructions on what constitutes the right amount of exercise activity for them. Gardening involves the arms, legs, and respiratory system. It exercises the heart muscles and aids circulation because the work effort results in an increased supply of blood and oxygen to the entire body."

Gross, who raises plants, flowers and tomatoes with his wife Ralphine at their country home, offered the following suggestions for seniors who want to garden:

Do not garden in intense heat, dry heat or under a burning sun. Wear a sunhat, even if you don't think you need one.

Do not garden to the point of fatigue, shortness of breath, or a thumping or pounding of the heart. "They've got to watch out for rapid heart beat action that doesn't stop when they stop gardening," Gross warned. "They should plan to do a small section of the garden. Then go back and do more if they feel up to it. But they have to stay away from planning huge tasks in the garden and then feeling obliged to finish these all up in one swoop. As one gets older competition must cease. They must not try to prove something with their garden."

Do not garden immediately after a meal. "I feel that as people get older they should change their eating habits and have four or five small meals a day instead of two or three large meals. I believe smaller amounts of food are easier for the body to handle. They should wait at least a half hour before they begin gardening."

"If a person, particularly those with a history of angina, develops any kind of pain, not only should they obviously stop and take their medication," said Gross, "but they must not rush back into the garden even though the pain has subsided. Forget it for a suitable time period, perhaps even for the rest of that day. This do-or-die attitude, that may have been present when the person was younger, must be put behind for the sake of their health," Gross declared.

Mrs. Gross shares her own gardening suggestions. "I break up my activities in the garden so that I'm using different muscle groups. If I've been using my legs a lot I stop, before I get tired, and switch to an activity involving my arms."

While some seniors are old hands at gardening others learn to garden in preparation for their retirement.

Mrs. Alice Smith, a secretary at the Brooklyn Botanic Garden, has enrolled in a gardening class there in preparation for her retirement to a farm in upstate New York.

"I grew up in the Flatbush section of Brooklyn which years ago was quite countrified," she said. "My father planted potatoes, string beans, swiss chard, and, can you believe it, even peanuts!"

In the "Gardening with a Trained Thumb" course, which meets during the spring and summer, Mrs. Smith worked a 5-by-18-foot lot at the Botanic Garden. Her crop included spinach, stringbeans, tomatoes, and other vegetables.

"Not only do I enjoy watching things grow and eating garden produce," says Mrs. Smith, who worked her plot with another student, Nancy Jacobson, "but it is definitely a form of exercise. The hoeing, raking, weeding, and walking are a lot of work. Believe me, you really do feel it when you first start—especially in the legs. My calf muscles really knew I was up to something!" ☘

The culture of plants from detached cells, tissues or organs in a nutrient medium . . .

RECENT DEVELOPMENTS IN PLANT TISSUE CULTURE

Vernon T. Stoutemyer and Ron Cooke

Reprinted with permission from PACIFIC HORTICULTURE, Spring, 1979

Plant propagation by means of tissue culture has recently become important in the production of orchids and of many house plants, particularly ferns. There are now at least fifty commercial tissue culture laboratories in the United States and the number is steadily increasing.

The possibility of culture of plant tissues and organs was first envisioned in 1902 by the German plant physiologist Haberlandt. All his experiments failed but his pioneering effort encouraged many investigators, and success for limited periods of time was obtained by several experimenters before 1930. Two notable advances were made in the following decade: White, in America, was able to culture tomato roots indefinitely in a solution containing sucrose, minerals, and the vitamin thiamine; in France, Gautheret and Nobecourt independently cultured cambial cells from trees using the same type of solution plus the newly discovered auxins.

Several important developments in the 1950's firmly established successful commercial propagation. The cytokinins were discovered, in the laboratory of Folke Skoog at the University of Wisconsin. These substances occur in plants and promote cell division, but closely related synthetic compounds may also have a similar action. With auxins, an interaction occurs *in vitro* to promote cell division and organogenesis, particularly bud formation.

Orchids, Ferns, House Plants

Ernest Ball, in America, was probably the first scientist to culture shoot tips. Morel, in France, was using this technique to free certain economic plants, such as dahlia, carnation and potato, from viruses. The technique depends upon the fact that viruses may not penetrate rapidly growing shoot tips. Morel found that with orchids in a suitable medium he could obtain bud proliferation which was particularly rapid in liquid cultures with some form of agitation. Shortly after 1960, the French orchid firm of Vacherot and Lecoufle propagated many choice selections of cattleyas, cymbidiums and other orchids by the Morel method. Since orchid firms all over the world had been growing seedlings for years in sterile culture vessels, they had both the technique and the equipment to apply the new method. Many of the orchid firms grew the so-called meristem cultures on glasshouse benches, under natural light. However, there is a trend towards the use of fluorescent light in culture rooms because it reduces the chance of contamination and gives more complete control of the environment, especially temperature. The orchid business was revolutionized by the use of meristem cultures. Previously, valuable new seedlings and imports remained scarce for a long time when conventionally propagated, and commanded high prices. Now even rare plants become widely available quickly, and at reasonable prices.

In recent years the enormous popularity of plants for interior decoration has stimulated the use of tissue culture to meet this demand. Many small palms, philodendrons, dracaenas, cordylines, aglaonemas and ferns, as well as florists' plants such as chrysanthemums, begonias and African violets, are being propagated in well-equipped commercial laboratories. During the 1970's the method proved particularly useful for the propagation of Boston fern which does not reproduce by spores. Enormous rates of reproduction (as much as a million-fold in one year) are theoretically possible with some of the plants grown from tissue cultures. Some woody plants such as *Tupidanthus* and some of the ornamental species of *Ficus* are now grown commercially by tissue culture.

Anderson (1977) calculated the cost of liner plants of a particular species from a $50,000 tissue culture laboratory to be between 15 and 16 cents each. The cost per plant may be more or less than this figure depending on the kind of plant and the particular tissue culture laboratory. However, some plants are still more cheaply propagated by conventional methods.

Vessels and Media

Various types of culture vessels are used, including test tubes, vials, flasks or bottles and even ordinary glass Mason jars. Most cultures are grown on an agar solidified medium containing chemical nutrients. A liquid medium is sometimes used and may be stationary or agitated.

Many ferns can be grown on the simplest type of medium which is essentially similar to that used by White in 1934 for root cultures. Plant tissue culture media generally contain some or all of the following components:

> *Major nutrient elements:* nitrogen, phosphorus, potassium, magnesium, calcium, sulfur. Many of the media are derived from the traditional plant nutrient solutions of the plant physiologists and experimenters in hydroponics.
>
> *Minor or trace elements:* boron, cobalt, manganese, molybdenum, copper, zinc, chlorine and iron which is often in chelated form.
>
> A carbon source, usually a sugar such as sucrose.
>
> The vitamins thiamine, niacin and pyridoxine are often added also. Inositol is often included along with the vitamins.

Several other classes of substances are required for some plants or are added to aid growth:

> An auxin, such as naphthalene acetic acid, indoleacetic acid or indolebutyric acid, is often added to induce root formation or to promote organogenesis when used in conjunction with cytokinins.
>
> Cytokinins are often required for organ formation. Kinetin, 6-benzyladenine and 6-(y,y-dimethyl allylamino) purine are most commonly used.
>
> Amino acids, usually glycine or tryptophane, may be added. Casein hydrolysate, which is a mixture of various amino acids, is sometimes substituted.
>
> Various undefined biological products may be added. These may contain vitamins, amino acids and perhaps unidentified growth factors. Examples are coconut water, malt extract, tomato juice, birch tree sap and homogenized bananas.
>
> Various largely-inert materials are sometimes added.

Powdered graphite may be added to exclude light and aid root formation. Activated charcoal may be used to absorb by-products which may be detrimental. Charcoal has been particularly useful in the propagation of woody plants.

Different plants require different formulations for best results. Large variations may need to be made in organic additives, particularly in the levels of auxin and cytokinin. The concentration of mineral salts must be reduced for a few plants. Prepackaged media are available in a variety of formulations. These are convenient, save time and help to prevent errors in formulation. The old-time photographer spent many hours compounding his solutions but modern darkroom technicians use only prepackaged chemical mixtures. Similarly, the modern tissue culturist need not maintain a chemical laboratory, but can purchase premixed media for specific needs.

The media must be adjusted to a suitable pH level, usually 5.7 for most agar solidified media. Liquid media and media for orchids are often more acid. The pH adjustment is usually done with electrometric equipment, but some satisfactory narrow pH range colorimetric plastic strips are now available and are inexpensive.

Techniques

Tissue culture (or callus culture) can be started from various plant parts. Callus is a proliferating mass of undifferentiated tissue and in some instances can produce certain chemical products as in the parent plant or can be induced in many cases to form plantlets. Cell cultures are produced by agitation of callus in liquid culture. This results in suspensions of single cells or cell aggregates. Flowers or portions of fruits can be cultured. Plants have sometimes been grown from anthers of pollen producing haploid plants; these are valuable in plant breeding as a means of producing homozygous plants. Tissue cultures have been treated with colchicine to produce polyploid plants. This is very commonly done with seedling or meristem flasks of orchids.

When cultures have been started using sterile techniques, they must be incubated at suitable temperatures. As might be expected the temperature requirements are lower for some alpine plants. Most cultures are maintained between 25° to 27°C.

Illumination is very important. Callus formation is most often done in complete darkness, but plantlet formation is usually conducted at comparatively low levels of illumination, perhaps 100 to 150 foot candles (about 1000 lux) and preferably at about 16 hours of illumination per 24-hour period. Plantlets are hardened off and prepared for transplanting at considerably higher levels of illumination.

Plantlets from tissue cultures are usually placed in flats or pots in standard growing medium and are maintained under conditions of high humidity. Once established, they are handled exactly as plants propagated by conventional methods of seeding and cutting propagation. However, there has been some marketing of plants as novelty items in the small sterile glass test tubes.

Trees and Shrubs

Woody plants have presented more difficulties in tissue culture than herbaceous plants because of season effects, juvenile-to-adult transformations and a greater tendency to form undesirable substances that may impair growth. The adult forms of woody plants are sometimes very difficult to root in culture and thus are more difficult to propagate. The addition of activated charcoal to the tissue culture medium has improved results in some cases.

One vineyard has recently been established with sixty-five plants propagated by tissue culture. Apple trees have been produced successfully by this method. The ability of these plantings to bear fruit remains to be seen.

Several *Ficus,* particularly *F. benjamina,* are being mass produced in tissue culture laboratories. A choice cultivar of *Nandina domestica* is being propagated by tissue culture and the technique is being investigated for propagation of conifers for forest planting.

Frontiers

There are other promising frontiers in plant tissue culture in addition to propagation and the elimination of virus. It is possible to produce medicinal products, enzymes and flavoring agents by tissue cultures. However, cultures that produce more secondary products than the parent plant have yet to be developed. Protoplast culture is also receiving much attention. By treatment with several enzymes it is possible to remove the walls of cells and culture the naked protoplasts. Methods have been devised to fuse these protoplasts and in a few cases it has been possible to grow a plant from the fusion of the protoplasts of two different species. This has been done successfully with tobacco species. This method carries the potential of developing many economically important hybrid plants.

The use of pollen or anther culture to produce haploid plants has attracted the attention of agronomists all over the world and an international conference on the subject has been held. Tissue cultures are also being used to produce polyploid plants, especially orchids. Although not practical at the moment, the introduction of foreign DNA into cells of tissue cultures as a means of producing new types of plants is beginning to attract attention. Additionally, tissue culture is a powerful tool for the basic research scientist working on certain problems of plant development and plant physiology.

Those who wish to study the subject will find specialized courses now available at many colleges and universities. Short courses of the workshop type are available several times each year at the W. Alton Jones Cell Science Center, P.O. Box 631, Lake Placid, New York 12946.

Two excellent inexpensive paperbacks on the subject have been published in England. They are available from New York representatives and may be ordered through your local bookseller. *Plant Tissue Culture,* by Butcher and Ingram (1976), is a practical work. *From Single Cells to Plants,* by Thomas and Davey (1975), is more theoretical.

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Getting help when it counts . . .

CONSUMER'S GUIDE TO NURSERY STOCK

Suggested Readings

American Horticultural Society—*Directory of American Horticulture.* Revised edition, Mount Vernon, Virginia

Virginia Beatty—*Consumer Guide to Indoor Plant Care.* Simon and Schuster, New York. Also *Consumer Guide to Rating and Raising Vegetables*

Brooklyn Botanic Garden—*American Gardens—A Traveler's Guide.* Brooklyn, New York. Also *Nursery Source Guide*

Jack Kramer—*The Free Earth Guide to Gardening.* Walker Publishing Co., New York

Saul Lapidus, ed. *The Greenhouse Catalog of Catalogs.* David McKay Co., New York

Judith Nelson—*Money Saving Garden Magic.* Prentice-Hall, Englewood Cliffs, New Jersey

Maggie Oster—*Green Pages: A Complete Indoor Plant Catalog.* Ballantine Books, New York

Thomas and Betty Powell—*The Avant Gardener.* Houghton Mifflin Co., Boston

Tom Riker and Harvey Rottenberg—*The Gardener's Catalogue.* William Morrow & Co., New York

(Continued)

Marion Schroeder—*The Green Thumb Directory.* Doubleday, New York

Brooklyn Botanic Garden Handbooks with nursery source lists:

African-Violets and Their Relatives
Annuals
Conifers
Ferns
Herbs
A House Plant Primer
Nursery Source Guide
Orchids
Perennials and Their Uses
Rhododendrons and Their Relatives
Terrariums

In addition, the Botanic Garden has available a list of bonsai sources. Please send stamped, self-addressed envelope to BBG, 1000 Washington Ave., Brooklyn, New York 11225.

Basic Reference Volumes

Liberty H. Bailey—*Manual of Cultivated Plants.* Macmillan, New York. Useful keys for herbaceous and woody plants. Never superseded.

Bailey Hortorium Staff, Cornell University—*Hortus Third.* Macmillan, New York. Expensive.

W. J. Bean—*Trees and Shrubs Hardy in the British Isles,* revised edition. four vols., three completed to date. John Murray, London. A wealth of background information.

Alfred Graf—*Exotica III.* Roehrs Publishing Co., Rutherford, New Jersey. The standard pictorial (black & white) encyclopedia for indoor plants. There is also *Tropica,* in color, by the same author. Both expensive.

Hilliers' *Manual of Trees and Shrubs*—Hillier and Sons, Winchester, England. In theory a nursery list, in fact the best current guide with concise descriptions.

P. den Ouden and B. K. Boom—*Manual of Cultivated Conifers.* Martinus Nyhoff, The Hague.

Roger Phillips—*Trees of North America and Europe.* Random House, New York. Numerous color photographs.

P. P. Pirone—*Diseases and Pests of Ornamental Plants.* Fifth edition, Ronald Press, New York.

Alfred Rehder—*Manual of Cultivated Trees and Shrubs.* Macmillan, New York. Never superseded.

Royal Horticultural Society—*Dictionary of Gardening.* Four vols. and supplements. London. Dist. by Oxford University Press, New York.

Graham Stuart Thomas—*Perennial Garden Plants.* Dist. by David McKay Co., New York.

Donald Wyman—*Shrubs and Vines for American Gardens.* Macmillan, New York.

Donald Wyman—*Trees for American Gardens.* Macmillan, New York.

Donald Wyman—*Wyman's Gardening Encyclopedia.* Macmillan, New York

Where to Complain

So it died and it wasn't your fault. Did you know the nursery's policy on guarantees before your purchase? First ask what the nursery might do to rectify the matter. No satisfaction? Let your state's Consumer's Protection Bureau know of it by letter, with a copy to the nursery. Copies to two trade organizations may help in some instances: American Association of Nurserymen, F. Raymond Brush, Secretary, 230 Southern Building, 15th & H Streets, N.W., Washington, D.C. 20005, (202) 737-4060; Mailorder Association of Nurserymen, William Wilson, Secretary-Treasurer, Wilson Brothers, Roachdale, Indiana 46172, (317) 596-3455. ❧

RECENT BOOKS WORTH NOTING

In the Library of the Brooklyn Botanic Garden

(Please order directly from your bookstore,
not from the Botanic Garden.)

For Children

The Amazing Earthworm by Lilo Hess. Charles Scribner's Sons, New York. $7.95

For younger children, especially those who can stomach the photographs, which say "Uggh" to the squeamish. Actually quite good of its sort.

Cactus in the Desert by Phyllis S. Busch, illustrated by Harriett Barton. Thomas Y. Crowell Co., New York. $6.95.

For the very young reader. The drawings are charming. Not much juice, though.

Plants in Danger by Edward R. Ricciuti, illustrated by Ann Zwinger. Harper & Row, New York. $8.95

Endangered and uncommon species, with a touch of their botany. For the older child and some adults.

Gardening

Complete Guide to Gardening by Better Homes and Gardens. Meredith Corporation, Des Moines, Iowa. $19.95

The title is an old chestnut, but an extensive range of information is covered (if lightly) in this attractive volume. The usual outdoor subjects, including lawns, are sketched, and the book has chapters on house plants and greenhouses.

Pruning by Christopher Brickell. Simon and Schuster, New York. Softcover $7.95

Numerous line drawings, virtually to the point of confusion, are characteristic of this spiralbound manual from overseas. It is part of a Royal Horticultural Society series that would have gained from editing for the American reader. Also available in the series is **Plant Propagation** by Philip McMillan Browse.

Crockett's Tool Shed by James Underwood Crockett. Little, Brown and Co., Boston. Softcover $9.95

A consumer guide of sorts to garden tools, by the late, lamented and loved Mr. Crockett, who helped unravel the mysteries of gardening to millions of people through his television show.

How to Garden by Jerome A. Eaton and Carroll C. Calkins. Alfred A. Knopf, New York. Hardcover $12.50, softcover $6.95

This introduction, which also includes a chapter on house plants, succeeds better than most. In addition to succinct chapters on annuals and perennials, there are ones on vegetables, woody plants, pruning and pests.

The Principles of Gardening by Hugh Johnson. Simon and Schuster, New York. $29.95

An ambitious but well conceived volume from England that is not so much an introduction to gardening as a review for the serious practitioner. There are

Turk's cap lily. Crispian van de Passe, *Hortus Floridus*, Arnheim, 1614-17.

numerous color photographs of fair-to-good quality, but the text is superior. In fact, one of the year's best. The section on garden composition is noteworthy.

Onward and Upward in the Garden by Katharine S. White. Farrar, Straus and Giroux. $12.95

Reprinting of a series of articles from *The New Yorker* on garden books of the 1960's, nursery catalogs, the author's favorite plants, and random subjects such as flower arranging and tulip variants. Dated but nicely written—and a pleasant divertissement for a winter evening.

The Home Gardener's Book of Ferns by John Mickel with Evelyn Fiore. Holt, Rinehart & Winston, New York. Hardcover, $12.95, softcover, $7.95

A welcome introduction, though more botanically slanted than the title suggests.

History, Travel, Art

Travels by Carl Linnaeus, edited by David Black. Charles Scribner's Sons, New York. $12.95

Extracts from reports on three expeditions by the Swedish naturalist, amply illustrated by Stephen Lee. Also in the series, same price, is **Insects** by Jean Henri Fabre.

Visiting the Gardens of Europe by Harriet Bridgeman and Elizabeth Drury. E. P. Dutton, New York. Softcover $9.95

A bit bulky for the pocket, but a first-rate guide to some one thousand gardens. Thumbnail descriptions, including hours of opening and whether tea is served. Great Britain and Ireland take up more than one-third of the book, as well they should.

Plants of Colonial Williamsburg by Joan Parry Dutton. Colonial Williamsburg Foundation. Softcover. Available from The Craft House, Williamsburg, Va. 23185 for $6.95 plus 75¢ postage.

Visitors to Williamsburg are often nearly as impressed with the gardens as with the buildings. This is a fine historical guide.

The Gardens of Pompeii by Wilhelmina F. Jashemski. Caratzas Brothers, New Rochelle, N.Y. $55.00

One of the year's most attractive volumes, and really an introduction to Pompeii as much as to its gardens. Vesuvius also snuffed out the life of Pliny. There are several hundred photographs, including many in color.

Botanical Illustration by Ronald King. Clarkson N. Potter (Crown Publishers), New York. Hardcover $14.95, softcover $6.95

A collection of forty full-page color paintings by Ehret, Redouté, Dürer and others. The reproduction is excellent, and more than one copy will be cut up for framing.

Japanese Gardens by Osamu Mori and Irmtraud Schaarschmidt-Richter. William Morrow and Co., New York. $70.00

A scholarly yet beautiful tome on how these gardens differ from those of the West in their symbolism, derivation from literature and natural landscapes, Zen influence and association with garden art. The forty color and 160 black-and-white illustrations are fine.

Paradise as a Garden in Persia and Mughal India by Elizabeth B. Moynihan. George Braziller, New York. $19.95

The symmetrical walled gardens of ancient Persia, Central Asia and India, as well as the influence of Cyrus the Great, Tamerlane, Babur and Shah Abbas, are cogently explored by a student of architecture. The literal meaning of paradise, an old Persian word, is "around the wall," which came to mean a walled garden.

Gardener's Delight by John Seymour. Crown Publishers, New York. $5.95

Garden lore is presented in this slim volume illustrated in color by Peter Morter. Plants of the herbals, especially vegetables, are discussed, with quotes from Pliny, Gerard and others.

Great Gardens of Britain by Graham Stuart Thomas. Mayflower Books, New York. $19.95

The National Trust gardens are discussed by one of England's most prominent horticulturists. "Must" reading before going on an English garden tour.

Caratzas Brothers, Publishers

A wall painting of a viburnum from *The Gardens of Pompeii.*

House or Greenhouse Plants

All About African Violets by Montague Free, revised by Charles Marden Fitch. Doubleday & Co., Garden City, N.Y. $19.95

The writings of Mr. Free, who served as BBG Horticulturist for over thirty years, have endured longer than most, but even they need an update from time to time. Charles Fitch, Guest Editor of the recent BBG Handbook on House Plants, has provided a fine one. Another book by Free, **All About House Plants,** has also been nicely revised for Doubleday ($12.95), by Marjorie J. Dietz, a former associate editor of Plants & Gardens.

Bromeliads for Home, Garden and Greenhouse by Werner Rauh. Sterling Publishing Co., New York. $45.00

One of the finest works on the subject, translated from German. Although this is especially useful for identification, Victoria Padilla's volume on bromeliads, published several years ago, is of greater pertinence for indoor growers here.

The Illustrated Encyclopedia of Succulents by Gordon Rowley. Crown Publishers, New York. $14.95

A respected English botanist reviews the wide-ranging plant families which have produced succulents. Background and culture. Should be of interest to the beginning collector. Color photographs.

Orchid Genera Illustrated by Tom and Marion Sheehan. Van Nostrand Reinhold, New York. $29.95

Some 61 genera are concisely described. There are handsome color drawings and maps showing the range of genera in the wild. Succinct cultural notes, including footcandle recommendations, for each genus mentioned.

Landscape Design

Photographic Manual of Woody Landscape Plants by Michael A. Dirr. Stipes Publishing Co., Champaign, Il. $14.60

The black-and-white pictures of several hundred trees and shrubs vary in clarity, but this compendium by a leading student should help gardeners who want an idea of unfamiliar kinds. There are brief descriptions, too.

Planting Design: A Manual of Theory and Practice by William R. Nelson. Stipes Publishing Co., Champaign, Il. Hardcover $14.00, softcover $9.00

For landscape designers, charts on the traits of selected shrubs and trees, as well as introductory chapters on the landscape art.

Color for Your Winter Yard and Garden by Helen Van Pelt Wilson. Charles Scribner's Sons, New York. Softcover $7.95

A veteran writer explores a garden season that doesn't get much attention. Trees in the North are leafless for half a year, so it is worth the effort to add color, in part through berried treasure, during the lean months.

Miscellaneous

Trees, Shrubs and Vines for Attracting Birds: A Manual for the Northeast by Richard M. DeGraaf and Gretchin M. Witman. University of Massachusetts Press, Amherst. $12.50

This Noble Harvest by Anne Ophelia Dowden. Collins Publishers, New York. $12.95

In Memoriam

It is with sadness that we report the passing of Kan Yashiroda. He was the author of Bonsai: Japanese Miniature Trees *(Faber and Faber, 1960) and twice a Teaching Fellow in Bonsai Culture at the Brooklyn Botanic Garden (1955 and 1963). In addition, Mr. Yashiroda guest edited four BBG Handbooks:* Dwarf Potted Trees; Bonsai: Special Techniques; Japanese Gardens and Miniature Landscapes; *and* Japanese Herbs and Their Uses. *He developed the Acclimatization Garden on Shodo Island in Japan's Inland Sea after studying at the Royal Botanic Garden, Kew, England, in the 1920's. We have heard from his daughter, Chie Matsuo of Kyoto, that he died on May 16, 1979.*

Herbs beautifully and precisely drawn in color. There is a brief text, but the author's fine brush really tells the story.

Dearest Andrew: Letters from V. Sackville-West to Andrew Reiber. Charles Scribner's Sons, New York. $8.95

A curious 12-year correspondence took place between two unlike people who never met, a retired actor living in Maine and the lady of Sissinghurst. This is not a horticultural book, but it sheds light on the complex personality of one of England's great gardeners.

The Complete Guide to Flower and Foliage Arrangement, edited by Iris Webb. Doubleday and Co., Garden City, N. Y. $19.95

The British sense of design is not the same, but this abundantly illustrated volume from overseas should suggest some ideas for designers here. There are 12 contributors. Tradition reigns, but chapters on modern design and Ikebana are included.

Native Plants, Mostly

Grasses: An Identification Guide by Lauren Brown. Houghton Mifflin Co., Boston. $9.95

Most gardeners can spot crabgrass and bluegrass, but what about downy chess and northern dropseed? Some sedges are included and, for flavor, wild garlic. The author's drawings are topnotch. A relatively painless introduction.

Pods: Wildflowers and Weeds in Their Final Beauty by Jane Embertson. Charles Scribner's Sons, New York. $14.95

Although of primary interest to the flower arranger interested in dried decorations, this pictorial volume should appeal to wildflower buffs because of the color photos of native and naturalized plants in blooming and fruiting stages. They are done by Jay M. Conrader.

The Audubon Society Book of Wildflowers by Les Line and Walter Henricks Hodge. Harry N. Abrams, New York. $35.00

A big, brassy coffee-table volume with excellent color photographs frequently blown up to full page. It is saved from being exclusively an art book by the lucid if rather sparse text.

The Audubon Society Field Guide to North American Wildflowers, Eastern Region, by William A. Niering and Nancy C. Olmstead. Alfred A. Knopf, New York. Softcover $9.95

This hefty pocket manual is bound to join Peterson and Newcomb in the rucksack. The color photos are clearer than in most such books. There is also a newly issued western edition in the series, by Richard Spellenberg.

Pests

Rodale's Color Handbook of Garden Insects by Anna Carr. Rodale Press, Emmaus, Pa. $12.95

Excellent photographs and concise descriptions, with range maps.

Westcott's Plant Disease Handbook, fourth edition, revised by R. Kenneth Horst. Van Nostrand Reinhold, New York. $32.50
Timely update of a standard reference. It has helped many growers over the years.

Roses

Peter Malins' Rose Book by Peter Malins and M. M. Graff. Dodd, Mead and Co., New York. $12.50
The different rose types are discussed precisely and at some length, as well as their planting, culture, pests, and winter care. Chapters on old and shrub roses. Mr. Malins has been BBG Rosarian since 1960; Mrs. Graff is a crusader for the New York City parks.

Roses You Can Grow, edited by Ann Reilly. Better Homes and Gardens, Meredith Corporation, Des Moines, Iowa. $3.95
A concise introduction with special attention given to varieties and culture. There are brief chapters on flower arranging and aesthetically pleasing garden companions for roses.

Vegetables, Fruits, Nuts

Unusual Vegetables, edited by Anne Moyer Halpin. Rodale Press, Emmaus, Pa. $12.95
The vegetable growing fad of the 1970's is over, but many gardeners who got to know zucchini a little too well have gone on to sorrel and scorzonera. This is a useful report on 79 veggies you won't find in the neighborhood market. Growing information and seed company sources are given.

Nut Tree Culture in North America, edited by Richard A. Jaynes. Northern Nut Growers Association (Broken Arrow Rd., Hamden, Conn.). $15.00
Thoroughly revised edition of a 1969 work, with articles by twenty five specialist growers. A fine introduction to walnuts, hickories and many lesser-known nuts.

Apples and Man by Fred Lape. Van Nostrand Reinhold, New York. $9.95
An enticing history of 'Northern Spy', 'Red Astrachan', 'Spitzenburg' and other apples disappearing from the scene. The author, who directs the George Landis Arboretum in Esperance, N.Y., has few kind words about 'Delicious', regular spray programs, and experiment stations that work for the producer, not the consumer.

The Good Green Garden by Peter Tonge. Harpswell Press, Brunswick, Me. Softcover $4.95
A collection of columns on more-or-less "organic" vegetable growing by a garden reporter for the *Christian Science Monitor*. Fast-moving, optimistic and nearly contagious.

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